OCTOBER 1952

APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER TRANSMISSION

INCLUDING AIR CONTROLS AND AIR CIRCUIT DESIGN; ELECTRICAL CONTROLS

DESIGN OF A HYDRAULIC SLOTTER . . . Pg 34

TORQUE CONTROL . . . . . Pg 38

HYDRAULIC MAINTENANCE . . . . . Pg 46

SELECTING ACCUMULATORS . . . . . Pg 48

AIRCRAFT CIRCUITS . . . . . Pg 50

HOW TO ASSEMBLE TUBE FITTINGS . . . Pg 60

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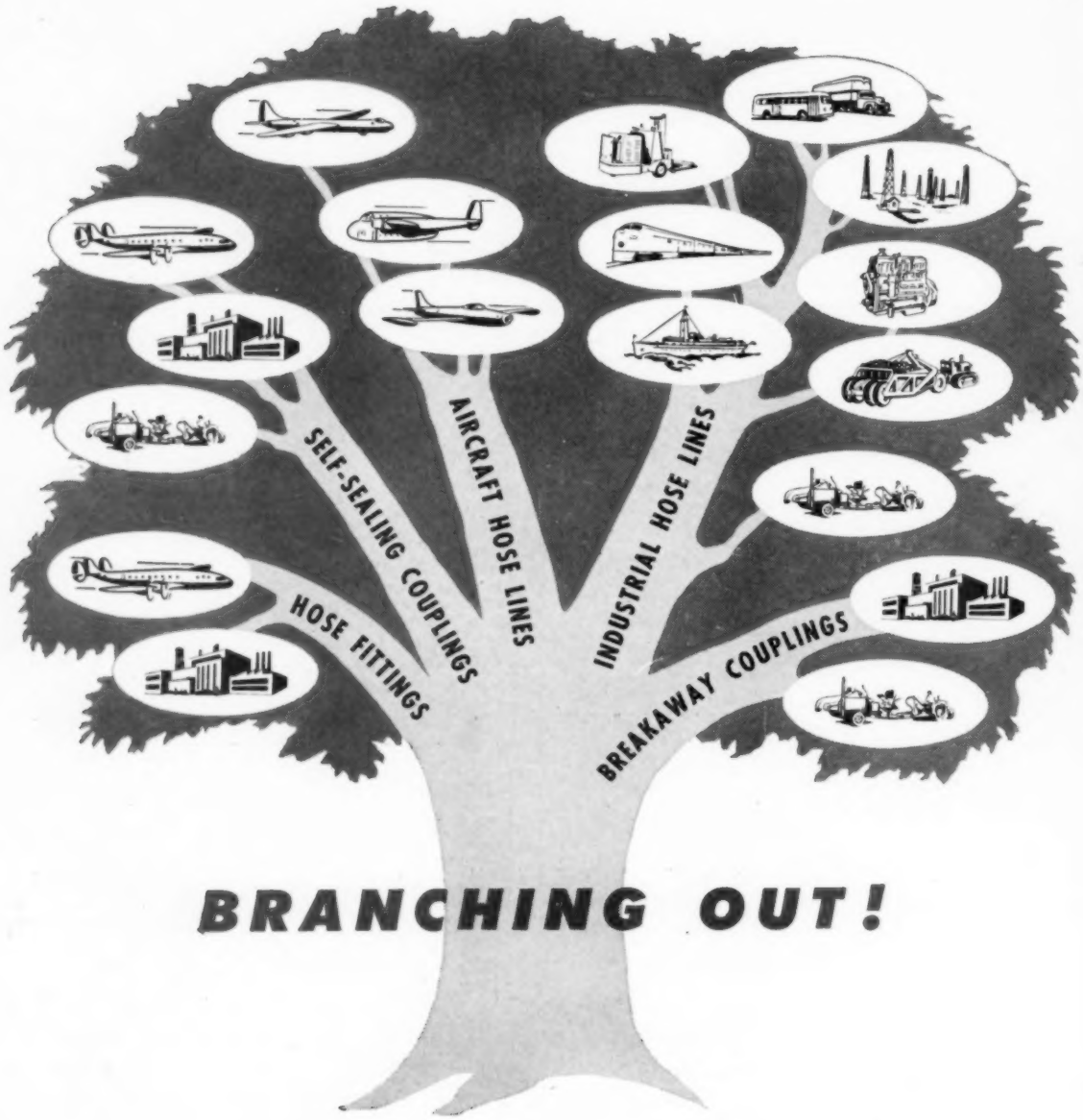

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The seed was planted only 12 years ago but the idea grew and grew. Now Aeroquip products serve dozens of major industries with a multitude of applications.

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The development of allied industrial products presented vast new opportunities. The "Aeroquip Idea"—bulk hose that can be cut to length and detachable, reusable fittings which can be easily assembled by hand—flourished among manufacturers and users of all types of industrial equipment. Even the farmer is counted among Aeroquip's customers.

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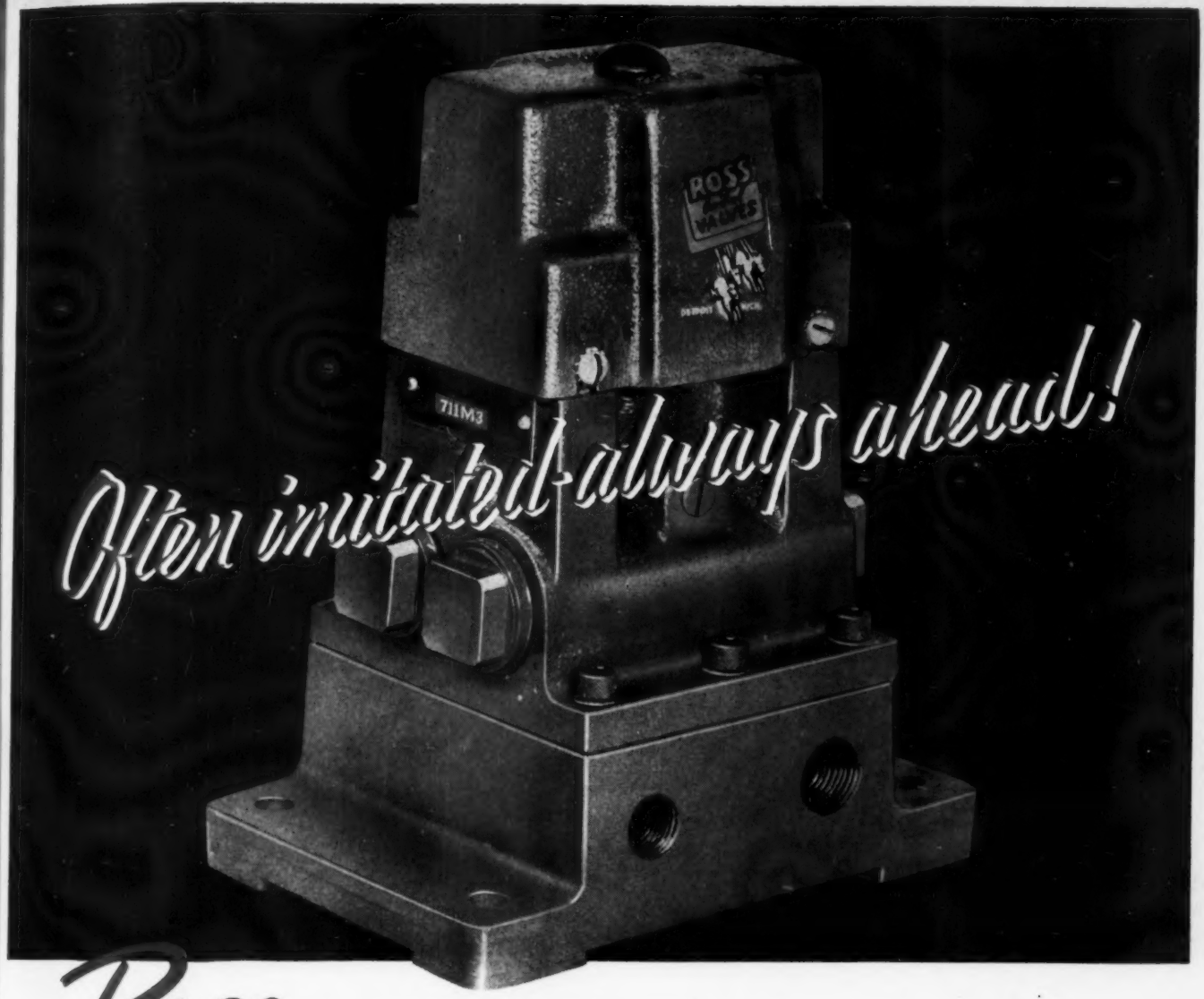

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OCTOBER, 1952
Vol. 5, No. 10

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WILLIAM J. HARGEST
General Manager

PAUL L. REED
Editor

PAUL ROLNICK
Associate Editor

WILLIAM L. JERSE
A. W. BENKENDORF
Production Department

EDWIN M. JOSEPH
Circulation Director

All communications should be addressed to APPLIED HYDRAULICS, 1240 Ontario St., Cleveland 13, Ohio. Phone SUperior 1-9622. AT&T Teletypewriter No. CV-233.

SALES OFFICES

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CONTENTS

PROGRESS IS AS PROGRESS DOES 33

THE GREATEST PROFIT TO THE USER 34
By Earle W. Johnson

TORQUE CONTROL in deep hole drilling eliminates tool breakage 38

THE BENDIX STORY on hydraulic maintenance 40

BEGINNERS' COURSE IN BASIC PNEUMATICS
Section II The Distribution System, Part I 43

AIR POWERED, OIL CONTROLLED CYLINDERS smooth machine production 46

DATA SHEET
How to Select a Hydropneumatic Accumulator 48

AVIATION SECTION
Auxiliary Hydraulic Systems on the T-29B 50
By T. H. Chadwick
Powered Flying Controls, Part 3 54
By F. J. Bradbury and S. M. Parker

ABSTRACTS OF NCIH PAPERS 57

HOW TO ASSEMBLE THREADED TUBE FITTINGS 60
Part 4 of a series on Fluid Lines
By R. W. Phillips

DEPARTMENTS

FLUID POWER LINES 4
LITERATURE OFFERED IN THIS MONTH'S ADS 12
LETTERS TO THE EDITOR 22
NEW COMPONENTS 69
POST SCRIPTS OF INDUSTRY 74
USEFUL LITERATURE 84
MARKET PLACE 95
ADVERTISERS' INDEX 96

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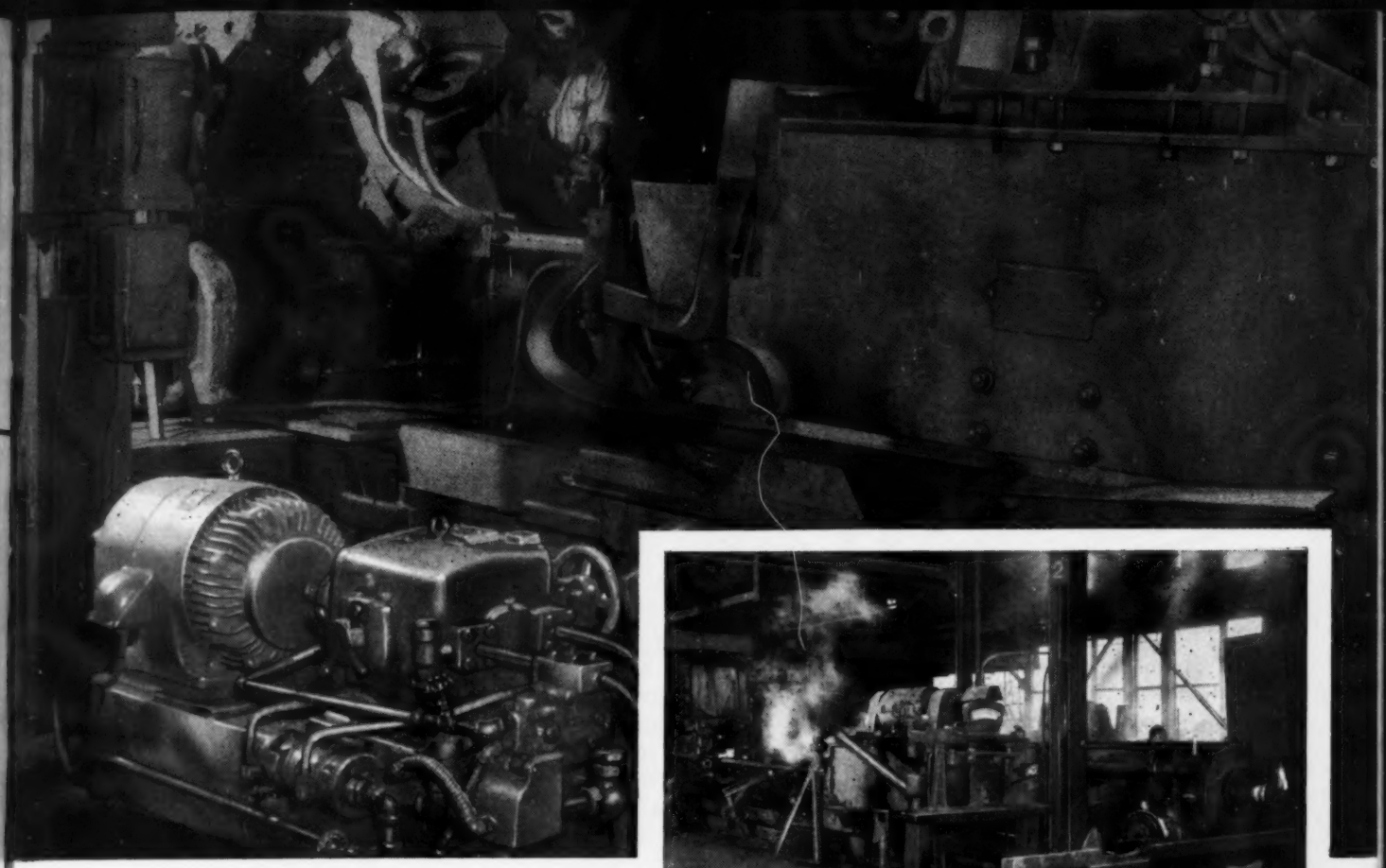
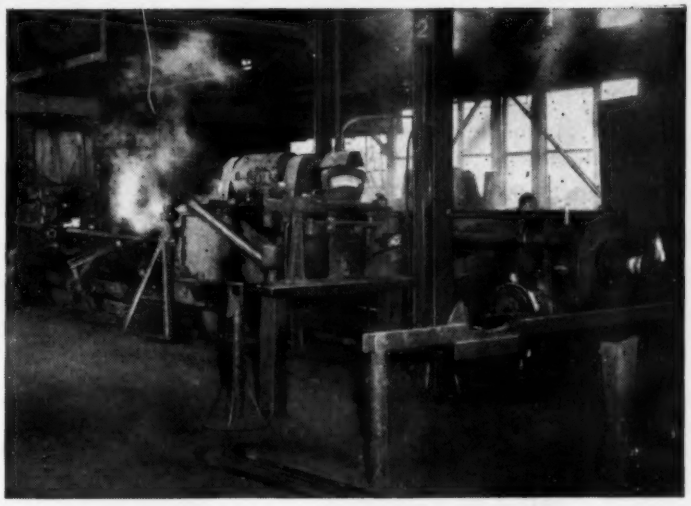




OILGEAR DRIVES ON GLAMORGAN CENTRIFUGAL PIPE CASTING MACHINE

Something more than 5 years ago, the Glamorgan Pipe & Foundry Company, of Lynchburg, Va., a leading manufacturer of cast iron pipe, designed its own centrifugal pipe casting machine, using Oilgear Fluid Power equipment to tilt the ladle and move the casting carriage.

The degree of control over pouring rate and carriage travel afforded by Oilgear has had almost unbelievable results. Scrap caused by irregularities in moving parts has become negligible. Weight controls are well within the close limits set by Industry specifications. Only 3 men are needed to operate the equipment. Despite the fact the machine has averaged 500 operations per day since 1948, maintenance on Oilgear equipment has totaled less than $200.00. The fumes and dirt necessarily present in foundry operations have had no effect on Oilgear fluid power equipment.

TYPICAL OF OILGEAR'S ABILITY TO SOLVE MACHINE DESIGN PROBLEMS

Sure it takes power to tilt a ladle and move a pipe casting machine carriage. But above all, it takes absolute and precise control of the speed of pouring and the speed of carriage travel if the product is to be perfect and uniform.

It not only takes power but power under control to print in register on flimsy cellophane at high speed, to set up paper piles for repetitive serial cuts to hairline register automatically, to cut fish on a continuous conveyor to accurate weight for canning, to vary the speed of a large beater automatically to conform sensitively to the changing viscosity of the mass.

These are all triumphs of Oilgear Fluid Power—where this flexible, controllable, versatile power leads the way to better machine design or to the solution of hitherto unsolved problems.

Think of Oilgear Fluid Power as identical with electrical power . . . generated by a pump . . . applied over conductors through a motor or motor element. But Oilgear Fluid Power can be converted into linear movement as well as rotary; can be exerted statically, without motion; can be varied infinitely, steplessly without additional equipment.

And the unique Oilgear design is oil hydraulic design at its simplest and best. It is generally accepted as the leader in its field. It will cost you nothing to see what Oilgear can do to improve the salability of your equipment . . . may profit you and your users in an amazing degree. THE OILGEAR COMPANY, 1564 W. Pierce St., Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

Fluid Power Lines

WE talked to many of the 625 engineers attending the two day Eighth National Conference on Industrial Hydraulics in Chicago during the first week of September. Those who had attended previous conferences agreed that this year's meetings were most valuable to the engineer in industry. Sixteen of the twenty papers were directly related to applications of oil hydraulics. For the first time emphasis was given to industrial problems in construction and maintenance of equipment. The increased and wide application of oil power has made experience in building and maintenance of hydraulic equipment very important to industry.

Air-Oil Circuits

We visited a friend who runs a one man machine shop. He's not sure whether the operation is courageous or fool-hardy, but we're sure that he's ingenious. He's always improvising to turn a multi-man job into a job that one man can do with the equipment on hand. Right now he is building a two headed boring machine right from the wood patterns for the castings to the carbide tool bits.

Watching him set up the air-hydraulic tool feeds we got to talking about the many applications on which a combination of air and oil is very effective. There's a short article in this issue showing several typical jobs and the simple air-oil circuit that can be applied.

Is There Oil on the Floor?

Just because your machines are oil powered your shop floor does not have to collect oil. Preventing slick floors doesn't require a saw dust brigade or an involved scheme of "catch pans". You need a maintenance program which, while keeping oil off the floors, will save you many dollars in machine time and oil costs.

"The Bendix Story on Hydraulic Maintenance" tells how the hydraulic maintenance department at the South Bend, Indiana Bendix Plant, has reduced downtime 75 percent on approximately 600 hydraulic machines over a period of six years. Training of pipefitters and electricians along with carefully kept machine records and the control of replacement parts pays off handsomely.

Profits For The User

It is axiomatic that machines are built and sold on the basis of earning a profit for the user. A design which will do a certain job is not successful unless it will do the job at a profit. Designers absorbed in developing a mechanism to perform an operation sometimes lose sight of the cost factor. There's a poem we have tacked to our drawing board which describes the designer who labors diligently over his board never going into the shop or finding out how existing designs may solve his problem. The last line of the poem reads: "Success at last, it can't even be cast".

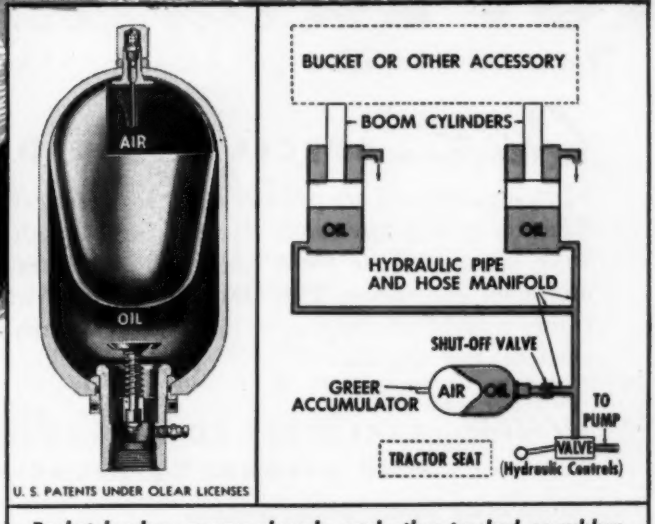
In describing the development of a hydraulically powered slotter, Earle W. Johnson, Rockford Machine Company's chief development engineer sets forth six major objectives which the designer must meet to give the greatest profit to the user.

Mr. Johnson's article includes simple force and velocity diagrams which illustrate the mechanics of the unique slotter design.

Electronics and Machine Tools

As the diameter of the drill gets smaller and the depth of hole gets larger, cost of drill replacements and scrapped or reworked parts usually goes up. On hand fed drills an experienced operator can, if the drill diameter is greater than 1/8 inch, feel the increase of work load due to built up chips. He returns the spindle, clears the chips and starts down again. On many of the automatic drilling machines, the control problem requires some electrically sensing device which tells the feed cylinder to retract. Timing relays can be used which will retract the drill a fixed number of times during the drilling cycle. This scheme may not be too efficient. An electronic torque control unit is used on the machine described in the article on deep hole drilling. Any torque build up on the drill which may be caused by wear as well as chips will actuate the feed control valves through the electronic sensing device, when a preset torque value is reached.

GREER ACCUMULATORS



U. S. PATENTS UNDER OLEAR LICENSES

Bucket loaders, power shovels, and other tracked or rubber-tired machines equipped with a Greer Accumulator are free from destructive as well as nerve-racking shock and vibration caused by rapid changes in momentum of the loaded bucket, or when traversing rough ground. Schematic diagram shows a typical application. Section shows simplicity of a Greer Accumulator.

Shock and vibration increase the maintenance cost and reduce the life of hydraulically operated equipment. A Greer Accumulator absorbs these shocks to an amazing degree. It prevents structural fatigue, increases life of components, permits operators to work in comfort, and greatly increases productivity of equipment.

Various Greer bulletins cover specific solutions of shock and vibration problems, including line shock suppression, pulsation dampening, and shock absorption on various types of equipment. Write us your problem.

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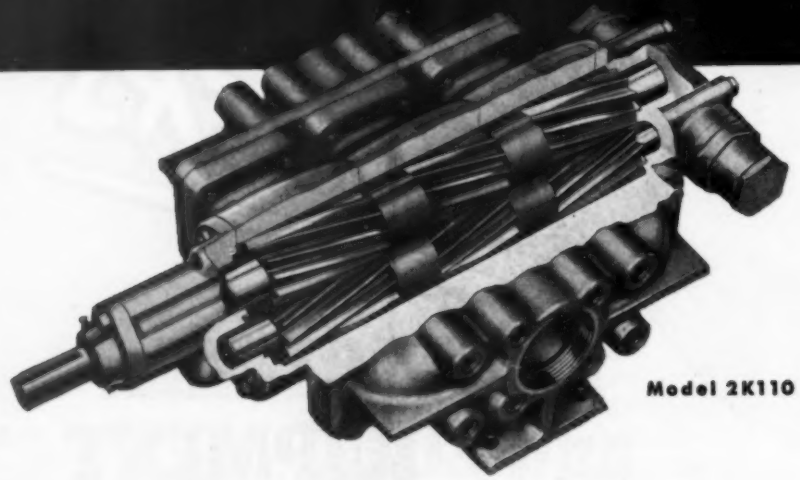


Model 2K110

ROPER *Elevator Pumps*

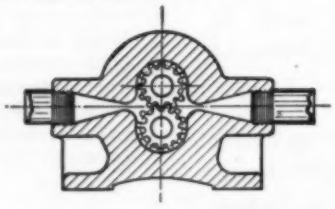
CAPACITIES FROM 25 to 110 G.P.M. at 300 P.S.I.

Quiet... SPECIAL GEAR DESIGN

Pumping elements are pairs of equal sized helical gears with small diameter giving low tooth velocity. Gear length provides a long wrap around of the tooth form and low helix angle results in minimum end thrust. This design — coupled with extremely accurate crossed axis lapping — makes the elements smooth running, efficient, and QUIET!

Quiet... EXCLUSIVE ROPER VENTURI SUCTION AND DISCHARGE PRINCIPLE

Action of the Venturi principle causes the flow form of oil to spread out across the full width of the gears and fill tooth spaces completely. Shape of the opening coordinates oil velocity to gear speed. Results: reduced turbulence, greater efficiency, QUIET oil flow.



Plus high lead bronze sleeve bearings ... hardened steel drive shaft ... easily adjusted built-in relief valve available at small extra cost ... pumps supplied with packed box or mechanical seal ... 3 sizes of pumps job-suited to your needs.

ROPER *Rotary Pumps*

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ROCKFORD, ILLINOIS

LITERATURE AND SERVICES OFFERED IN THIS MONTH'S ADS

For more information circle numbers on the reader service card bound in this issue.

LUBRI-FILTER for the protection of air driven equipment is described in Bulletin AH 10 by Jarett Compressor & Equipment, Inc.

Circle 43 on Reader Service Card

STEEL HYDRAULIC PIPE AND TUBE FITTINGS are described in a catalog offered by L & L Mfg. Co. Selection of shapes and sizes are shown.

Circle 45 on Reader Service Card

ELECTRIC MOTORS for hydraulically operated equipment are described in literature offered by the Electro Dynamic Division of General Dynamics Corp.

Circle 20 on Reader Service Card

LEATHER PACKINGS, their applications and advantages are detailed in a data file containing specification sheets and illustrations offered by J. E. Rhoads & Sons.

Circle 69 on Reader Service Card

CORED AND SOLID BRONZE BAR STOCK which shows great resistance to heat and wear, is described in literature available from the American Crucible Products Co.

Circle 4 on Reader Service Card

PUMPCUPS for air or hydraulic mechanisms are discussed in Bulletin 4502 offered by the Darling Valve & Mfg. Co. These are made in standard as well as many special compositions and textures for a wide range of temperature and pressure conditions.

Circle 15 on Reader Service Card

Longer Life...

designed and built for *extra* operating stamina

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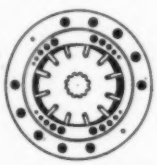
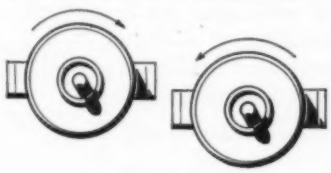
PUMP/MOTOR

For circuit needs up to 2000 psi



Complete Radial Balance

Hydraulically balanced vanes reduce load on the cam ring and *retain low loading characteristics at all* operating pressures. In addition, twin exhaust and inlet ports provide radial balance for the rotor. The combination of balanced vane and rotor give you that extra margin of long, trouble-free service under all conditions.



Bi-Directional Operation

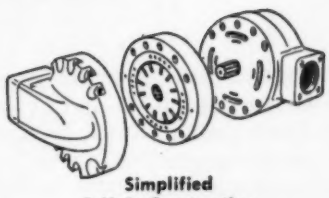
All Pump/Motor models may be used for either clockwise or counter-clockwise rotation—operating with equal efficiency in either direction!

Every feature of Denison's compact, dual-purpose Pump/Motor is designed to *stand up longer* under continuous, heavy-duty service at 2000 psi.

Hydraulically balanced vane and rotor action means smooth, uniform, radially balanced operation. It assures minimum wear on both the vanes and the cam ring, and reduces surge and pulsation to a minimum. For added assurance of higher efficiencies, vanes are designed to contact the cam ring with *dual sealing edges.*

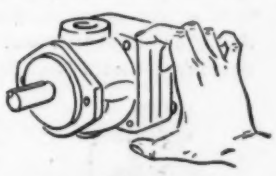
Four sizes, each offering a series of interchangeable cam rings, provide capacities to meet your specific need. Operating at 1200 rpm and 2000 psi, they offer pumping capacities from 2.7 to 70 gpm. As *motors,* their torque ratings range from 13 to 257 pound-inches per 100 psi. And all models are *ready to operate* as either pumps or motors, without alterations of any kind.

Wherever you need rugged power for circuits developing up to 2000 psi, Denison Pump/Motors offer the finest money can buy. Write today for bulletin P-5.



Simplified 3-Unit Construction

Simplified construction featuring only three major components — with interchangeable cam rings for each different pumping cartridge — add still further to the versatility and long service life of Denison Pump/Motors.



Rugged, Space-saving Compactness

Compact construction makes Denison Pump/Motors easier to adapt to any circuit plan. Model TMB12, shown above, delivering up to 7.5 gpm at 2000 psi is only 4⅛" high, 4⅛" wide, and 8" long including the shaft.

The DENISON Engineering Company

1166 Dublin Rd., Columbus 16, Ohio

SPRAGUE

MODEL S-404 *Air Operated Hydraulic Test Unit. Fully equipped with all necessary instruments, controls and connecting hoses. Ready for immediate operation.*

PORTABLE HYDRAULIC POWER UNIT

For Simplified Testing of Aircraft Hydraulic Components and Systems

USES—Model S-404 is designed for simplified testing at high pressures—500 to 5000 PSI—and at low flows—approximately 1 GPM at 2000 PSI. Use it for (1) Static testing of complete airplane systems. (2) Operation of subassemblies in which hydraulics are installed before final assembly such as wings, nose assemblies, etc. (3) Operation of simple systems during service such as flaps, wing folding, cowl flaps, doors. (4) Testing of relief valve settings. (5) Proof-testing hose assemblies. (6) Testing of hydraulic cylinders. (7) Operating power brakes and many other uses.

Douglas, Lockheed, Martin and other major aircraft companies are ordering this versatile, low-cost, test unit by the dozens. Portability permits tests at any point reached by plant air supply lines. Speeds work—saves tieing up expensive test equipment for simple test jobs. Write for Engineering Bulletin No. 400 which gives circuit and complete specifications.

AVAILABLE SEPARATELY—Heart of the Model S-404 and of several other Sprague Test Machines is the Sprague Model S-216-C Air-Operated Hydraulic Boost Pump which is available as a separate unit for custom installations. Measures 8¼" wide x 9½" deep. Simple, reliable, inexpensive. Thousands in use.

SPRAGUE ENGINEERING & SALES CORP.

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LOW CARBON STEEL TUBING and its advantages have been outlined in literature offered by Superior Tube Company.

Circle 80 on Reader Service Card

HIGH PRESSURE 2-WAY SHUT-OFF COUPLINGS permit quick, easy and safe connecting and disconnecting of hydraulic and pneumatic lines, with both ends of line positively sealed when coupling is disconnected. The Hansen Manufacturing Co. has outlined these couplings in a catalog, giving complete range of types and sizes

Circle 35 on Reader Service Card

PORTABLE HYDRAULIC POWER UNIT designed for simplified testing of hydraulic components and systems, to permit tests at any point reached by plant air supply lines is described in Engineering Bulletin No. 400, offered by Sprague Engineering and Sales Corp. Also given are circuit specifications.

Circle 75 on Reader Service Card

TENSION LINKAGES is the title of Bulletin No. 51-10 offered by the Chain Belt Co. The bulletin covers typical examples of tension linkage applications, helpful data on equipment selection, tables of dimensional data and other important facts.

Circle 10 on Reader Service Card

GEAR PUMP having perfectly matched gears, which permit operation under higher pressures and insure peak efficiency for a longer time, is detailed in Catalog H 4 available from The Commercial Shearing and Stamping Co.

Circle 12 on Reader Service Card

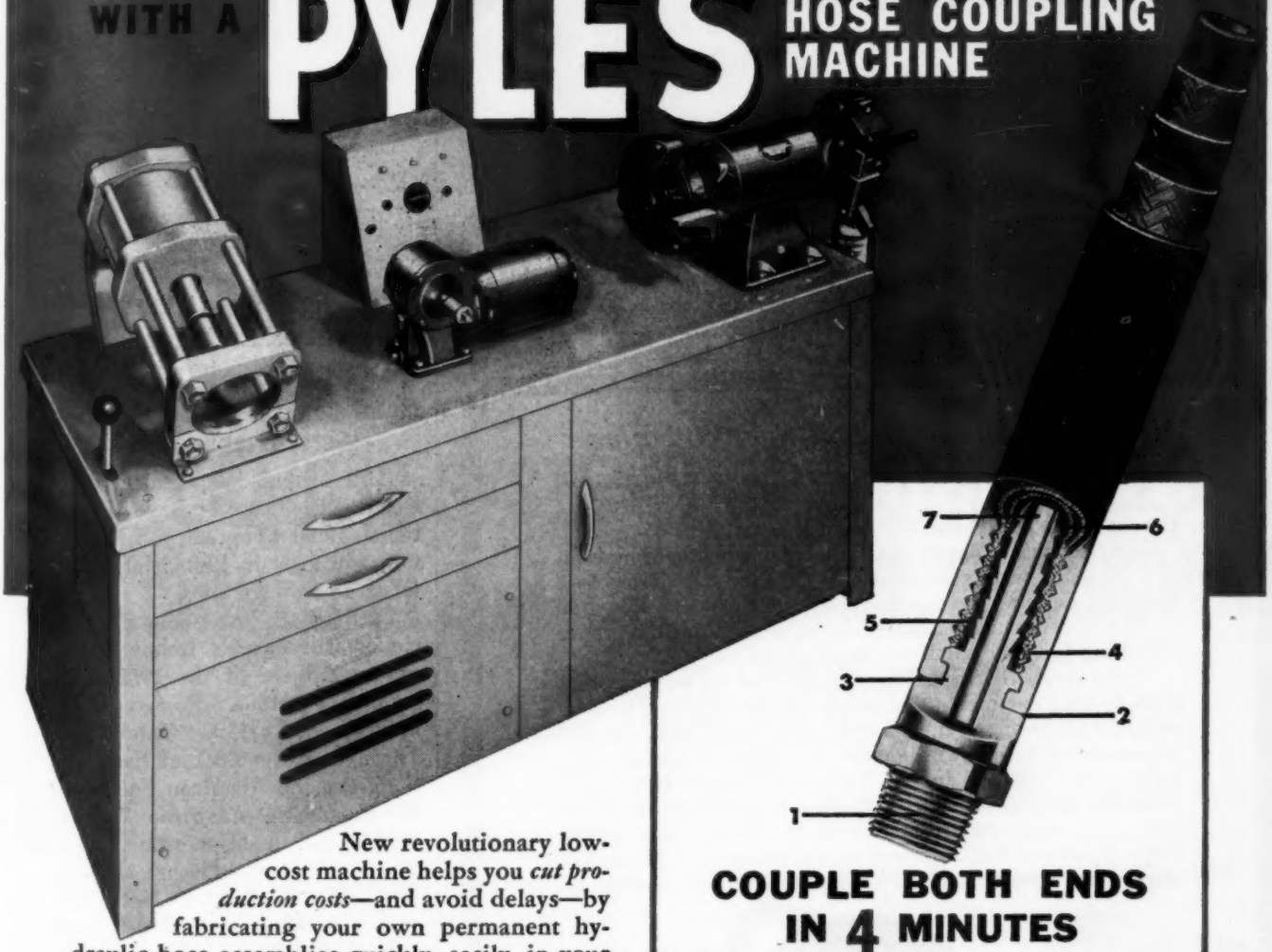
HYDRAULIC TEST EQUIPMENT, compact, fully automatic and portable for site testing and available in a complete range of 34 models, single and double acting for rapid testing of valves, pressure vessels, pipes and fittings, is detailed in an illustrated brochure offered by Davies Brothers.

Circle 16 on Reader Service Card

Save time... Cut costs!

MAKE YOUR OWN HYDRAULIC HOSE ASSEMBLIES WITH PERMANENT COUPLINGS FOR GREATER PRESSURES

WITH A PYLES HOSE COUPLING MACHINE



New revolutionary low-cost machine helps you *cut production costs*—and avoid delays—by fabricating your own permanent hydraulic hose assemblies quickly, easily, in your shop.

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3. Stem and ferrule LOCKED permanently in assembly.
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Complete data instantly available for pneumatic or hydraulic "O" Ring Sealing applications—in slide rule form. As a service to engineers PARCO has produced this "tell all" guide which will save much valuable time in determining the proper "O" Ring for your particular applications.

PARCO synthetic elastomers compounded to perform, continue to hold the lead in the rubber engineering field—whenever it is necessary to effect a dynamic or static seal, you will get maximum results with PARCO "O" Rings. Precision tolerances up to 1/1000 of an inch if required. Custom compounds from six basic synthetic elastomers—plus natural rubber to meet your exact specifications. Write our Engineering Service Dept. today for full information on PARCO "O" Rings. All Army-Navy specification "O" Rings are available from stock.

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AIR AND HYDRAULIC CYLINDERS furnished with cartridge type packing glands, are detailed in engineering data offered by Petch Manufacturing Company.

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MACHINE FOR MAKING HYDRAULIC HOSE ASSEMBLY is discussed in Bulletin No. 8 available from Pyles Industries, Inc.

Circle 67 on Reader Service Card

GEAR PUMPS whose pumping elements are pairs of equal sized helical gears with small diameter giving low tooth velocity, are described in Bulletin 20, prepared by Geo. D. Roper Corp.

Circle 70 on Reader Service Card

Metal Congress and Exposition Sets October Dates

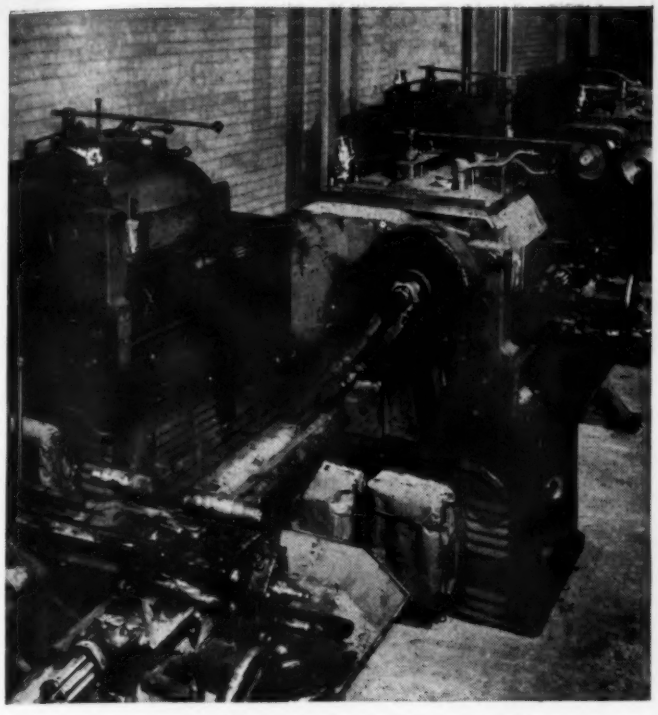
Built around the theme "Metal Keeps The Peace", the 34th National Metal Congress and Exposition will meet in Philadelphia, October 18 through 24.

Each of the five sponsoring societies will have a technical program. Subject of the 1952 ASM Seminar is "Modern Research Techniques in Physical Metallurgy". Throughout the week of the Metal Congress, the American Society of Metals and the American Welding Society will hold morning, afternoon and evening technical meetings. The Institute of Metals Division, AIME, will hold daily and evening technical sessions Monday through Wednesday. The Society for Non-Destructive Testing will hold sessions during four days of the week.

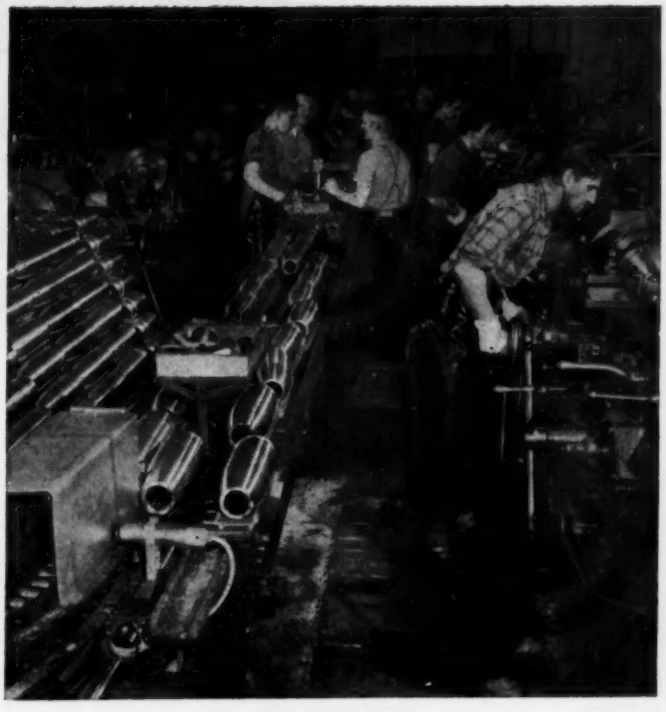
Over 400 nationally-known firms engaged in either the production of metals, the treatment of metals, the fabrication of metals into component parts or products, or in rendering services to all of these will have exhibits set up in the Philadelphia Convention Halls.

Managing sponsor is the American Society of Metals, whose secretary, W. H. Eisenman, is managing director of the congress and exposition, assistant director is Chester L. Wells.

Circle 65 on Reader Service Card



HYDRAULIC SYSTEMS CONTAMINATED by external rust preventive which had seeped into the working parts. Hoffman anticipated a complete machinery teardown.



CLEANED WITHOUT TEARDOWN. Sunvis H.D. 700 Oils freed hydraulic systems and internal parts, enabled Hoffman to start production within the time specified by the Navy.

HYDRAULIC SYSTEMS OF MOTHBALLED MACHINES CLEANED WITHOUT TEARDOWN BY SUNVIS H.D. 700 OILS

Recently the U.S. Hoffman Machinery Corporation was asked to reopen a World War II Navy-owned shell-making plant and start production in three months. The machinery, idle for 5 years, had been protected by an external layer of rust preventive. Hydraulic lines were among the parts coated, and some of the protective material had seeped into them. It looked as if the machinery might have to be torn down to be cleaned.

Sun and several other oil companies surveyed the equipment and suggested cleaning methods. Hoffman chose Sun's recommendations because of their soundness and Sun's record for reliable service in other Hoffman plants. Sunvis H.D. 700 Oils freed up the hydraulic systems, many of which were extremely sluggish; and the detergency of these oils flushed away every trace of sludge and rust preventive. Sun Spirits did the external cleaning job. No dismantling of equipment was necessary.

Let Sun help you solve your hydraulic, metalworking and lubrication problems. Write for your copy of "Sunvis H.D. 700 Oils" or for the services of a Sun representative, without obligation, of course. SUN OIL COMPANY, Department AH-10, Philadelphia 3, Pa.

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Calcium Carbonate Slurry
Calcium Sulfate Slurry
Casein Solutions
Cement Slurry
Chocolate
CO_2 Gas
Crude Oil
Dairy Products
Dye Solutions
Edible Oils
Ethane
Fish Oils
Formaldehyde
Fresh Water
Gas, Manufactured
Gas, Natural
Gasoline
Glucose
Glue
Glycerine
Glycols
Hydrochloric Acid
Hydrofluoric Acid
Ink
Jam
Jelly
Ketchup
Lacquer
Latex
Mash
Methane
Milk
Molasses
Naptha
Nitric Acid
Nitrogen
Oil, Crude
Oil, Refined
Oxygen
Paint
Potassium Hydroxide
Propane
Raw Boiler Feed Water
River Water—Dredging Operations
Rosin
Salt Water
Shortening
Sludge
Soap
Sodium Chloride Solution
Sodium Silicate
Sodium Sulfate Solution
Starch
Sulphuric Acid
Sump Water
Sweet Water
Tomato Juice
Varnish
Vinegar
Viscose
Water (various)
Wax
Whey

THIS list of fluids will give you a rough idea of the diversity of pumping jobs in which Darcova Pumcups are responsible for really *big* savings.

It boils down to the fact that Pumcups all but eliminate fluid slippage *throughout* their life span . . . and they *last many times as long as other packings.* Think of the down-time avoided, the production gains due to prolonged high efficiency, and the time-and-money-saving reduction in maintenance!

Years of application research have gone into the development of Pumcups. Made today in standard as well as many special compositions and textures for a wide range of temperature and pressure conditions, they offer you superior cost-cutting service in virtually *any* pumping job, simple or tough! And they're available in diameters from 1 to 20 inches.

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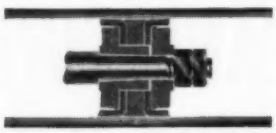
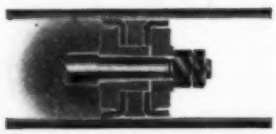
Why not weigh *all* the facts? Bulletin 4401 covers Darcova Pumcups for reciprocating pumps; Bulletin 4502 on Pumcups for air or hydraulic mechanisms. Write for yours today.

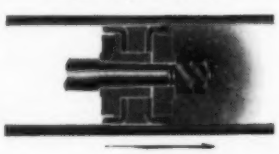
DIAGRAM OF DARCOVA PUMCUP ACTION (greatly exaggerated)



NORMAL: BOTH PUMCUPS RELAXED



UNDER PRESSURE: PUMCUPS SEAL AGAINST CYLINDER DESPITE WEAR, MINIMIZING SLIPPAGE



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DARCOVA
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PUMCUPS

LETTERS to the Editor

I have enclosed a check for $3.00 for a one year subscription to APPLIED HYDRAULICS. I will be very much interested in the outline of the course in Industrial Hydraulics. I am feeling my way in my own new course and any information will be very helpful.

DONALD BRADBURY
Head, Department of Mechanical Engineering
College of Engineering
University of Rhode Island

A revised outline of the course in Industrial Hydraulics will shortly be sent to you. EDITOR'S NOTE: The training course referred to covers 16 two hour periods of instruction in the fundamentals of oil hydraulics with special reference to industrial applications. Copies of the outline will be available to instructors and plant training supervisors upon request.

I am very much interested in the series of articles "A Beginners' Course in Basic Pneumatics". Would it be possible for me to obtain tear sheets on previous installments including Part VII.

A. A. LOFRANO
Engineering Department
American Maise-Products Co.

A set of tear sheets has been sent to you. Because of the demand for these installments, we cannot fill all requests for back copies or sets of tear sheets. However, this series will be reprinted in booklet form when the entire series is completed. We will accept reservations for the complete reprint, the cost of which will be nominal.

Would you please advise us where we may secure information on the Föttinger (Föettinger) hydraulic gear.

E. C. CURETON
Chief Engineer
Sibley Machine & Foundry Corp.

Complete information is available from Schnieder Manufacturing Co., Muncie, Indiana. Both members of this firm, Heinrich and Adolph Schneider were associated with Dr. Herman Föttinger, the originator and carry on the development of this type of hydraulic gear.

In your "Beginner's Course in Basic Pneumatics" June installment (Part V) example (a) columns one and two you give the following equation:

$$FP = \frac{IP \times IV \times FT}{FV \times IT}$$

In the solution, actual instead of absolute temperatures have been used. Should not these be the same as examples (b) and (c) which immediately follow?

LEONARD L. BOSKEN
Plant Engineer
The Cambridge Tile Mfg. Co.

Yes, Mr. Bosken, you are correct. For those who are preserving their installments, we suggest this item be clipped and filed with June issue:

We solve with the formula

$$FP = \frac{IP \times IV \times FT}{FV \times IT}$$

IP = 14.7 psi
IV = 25 cu ft
FT = 200 plus 460 = 660 F Abs T
IT = 60 plus 460 = 520 F Abs T

$$\frac{14.7 \times 25 \times 660}{15 \times 520} = 31.1 \text{ psi final pressure}$$

A very good customer of ours is in need of a hydraulic water pump developing 2000 psi pressure with a capacity of one gallon per minute and have asked us to obtain some information as to price and availability. We would appreciate the name of one or more manufacturers of this item.

PAUL J. CHRISTENSEN
Aviation Service Supply Co.
Stapleton Airfield

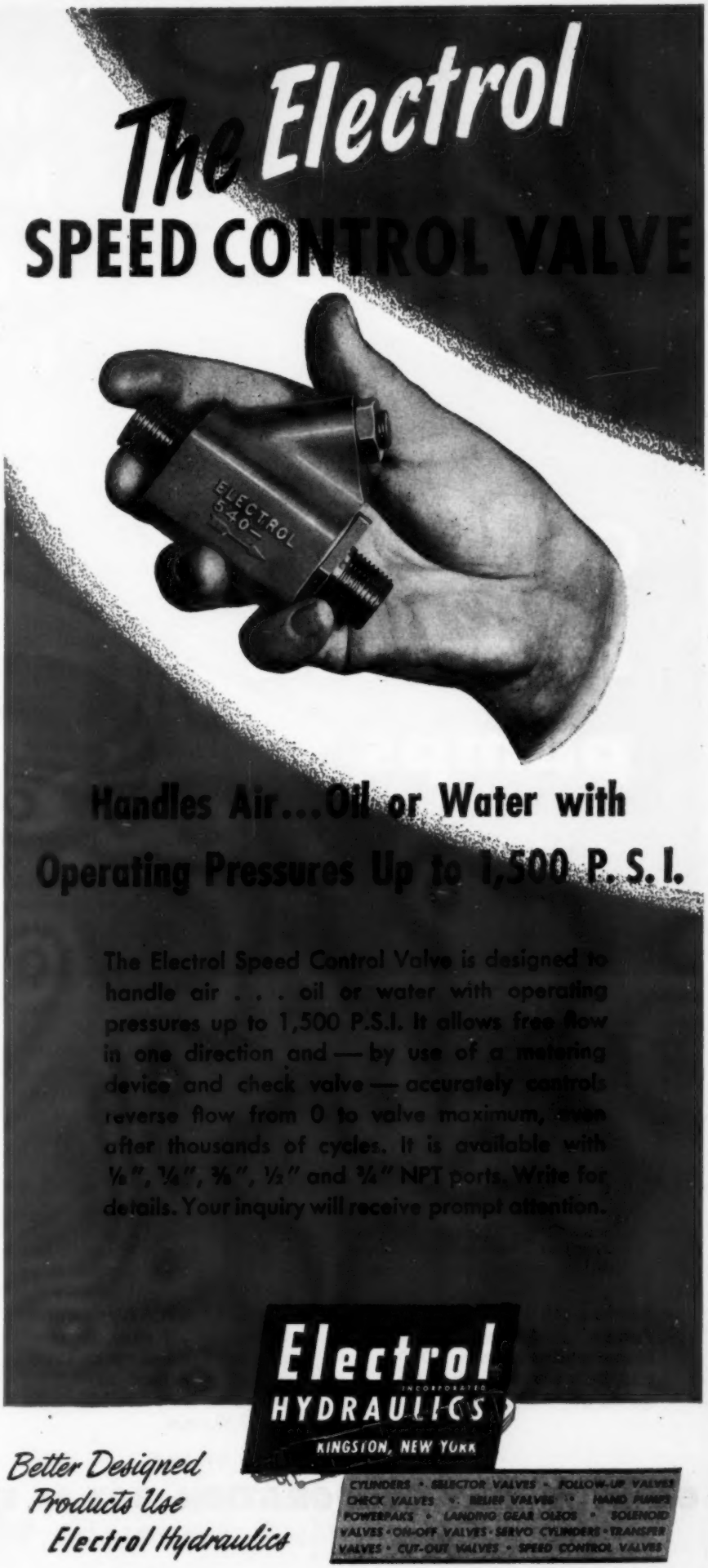
As far as we know, no standard pump of this type is available. It may be possible that your customer can use a proportioning type pump such as furnished by Milton Roy Company, 1300 E. Mermaid Lane, Philadelphia, Pa., or Proportioneers, Inc., 399 Harris St., Providence, R. I. There are several organizations in the west that might build a special pump for this purpose. The Rucker Company, 4228 Hollis St., Oakland, Calif., for example, might be contacted.

Your issue of July 1952 contained an article of great interest to me. It was "O" Rings in Rotary High Speed Applications". I would appreciate another set of tear sheets of this article.

ED. PICKETT
Birmingham 9, Ala.

A set of tear sheets of this article has been sent to you.

Continued on page 30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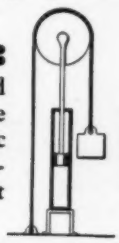
got a TENSION LINKAGE problem?

If you design hoists, lift trucks, counterweight suspensions, controls or any type of equipment where you must transmit pull or lift something, Baldwin-Rex® Roller Chain, Leaf Chain or Block Chain is likely to be the answer to your linkage problem.

here's a good example:

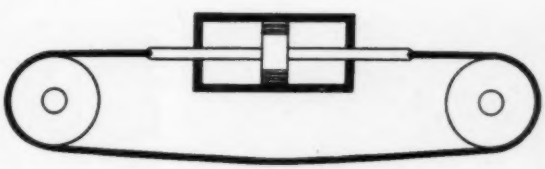
Increase of travel distance on a hydraulic lift. The chain, fixed at one end, passes over the sprocket, and is attached to the lift platform. The sprocket shaft is carried on the hydraulic plunger rod. In the arrangement illustrated, vertical movement of the platform is twice that of the plunger. Movement



is frequent and shock loads are severe, so *chain* is the answer. If the lift is mounted on a truck, severe shock and fatigue stresses are imposed on the chain as the truck moves.

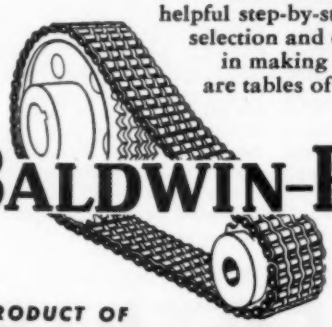
here's another one:

Transmission from a double-acting hydraulic cylinder to a shaft. Since motion must be transmitted in two directions, an idler sprocket is required as shown in the illustration. Since operation may be practically continuous, and shock effects are probable, *chain* is the answer. When this type of installation is applied to rudder control, shock and fatigue considerations are especially important.



our Tension Linkage bulletin

Covers typical examples of tension linkage applications . . . helpful step-by-step data on equipment selection and examples to guide you in making your selections. There are tables of dimensional data and other important facts you'll find useful in your work. Send for your free copy today. Just fill in and mail the coupon below. There is no obligation.



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Company..... *Dept*.....

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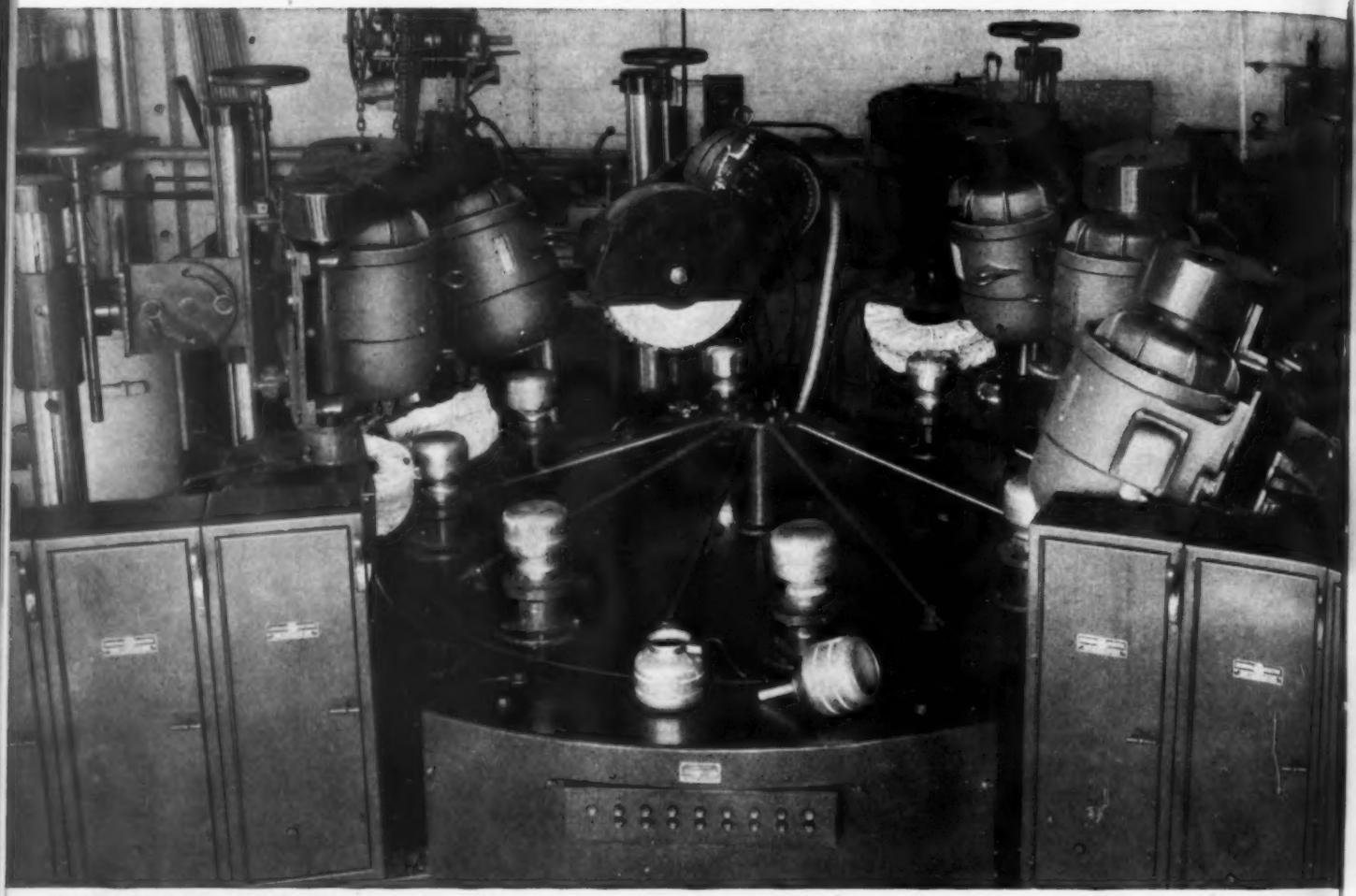
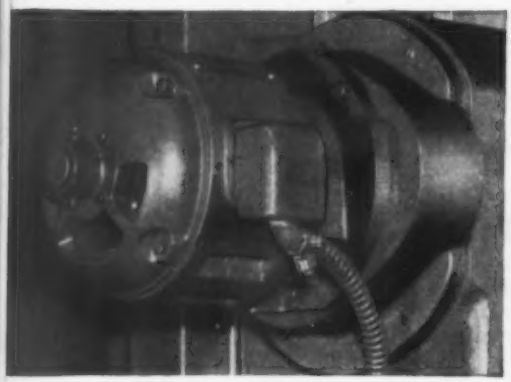
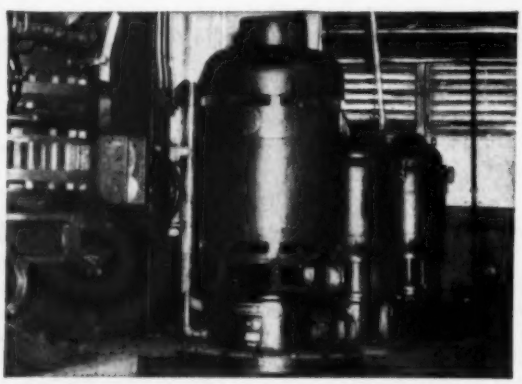
DESIGNERS' PROBLEMS



RIGOROUS OPERATION: on continuous duty in various positions, these six standard 7½-hp totally-enclosed, fan-cooled Tri-Clad motors run machine which automatically polishes 500 to 1000 coffee-makers per hour! Rigid Tri-Clad motor construction permits mounting in any position, and the motor frame won't twist out of shape even if mounted on an uneven surface! Note how modern design of motors blend with machine appearance.



FLANGE-MOUNTED and face-mounted Tri-Clad motors are easily adapted to equipment designs to save space and improve machine appearance. As in all Tri-Clad motors, this one features completely enclosed bearings that last longer because they can be relubricated if necessary.



VERTICAL motor applications are simplified by NEMA standard type P bases used on both solid- and hollow-shaft Tri-Clad vertical motors. Above, Tri-Clad motors run circulating water and condensate pumps of large surface condenser.

LOW-SPEED POWER, compact design and dependability were design problems on this rotary-hearth billet conveyor—all solved with Tri-Clad gear-motors. Planetary gear system gives smooth operation, reduces mechanical losses to a minimum.

GENERAL ELECTRIC

SIMPLIFIED BY USING TRI-CLAD MOTORS

REG. U.S. PAT. OFF.

Your problems in designing motorized products or installations are greatly simplified when you work with the G-E Tri-Clad motor line. Not only will you find the widest variety of types and ratings to fit your exact needs, but the flexibility and interchangeability of components are also to your advantage.

EXTRA SERVICE

When you design a product with a Tri-Clad motor, you are assured of help from the largest staff of motor experts in the country.

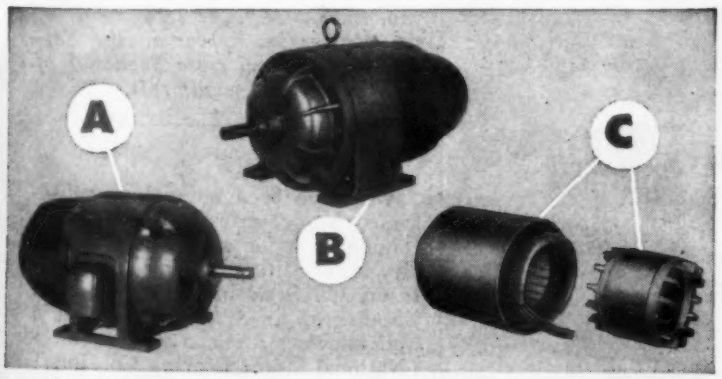
Moreover, the most complete service shop network in the motor industry backs up Tri-Clad motors on your products —another reason designers prefer Tri-Clad motors.

EXTRA PROTECTION

Every Tri-Clad motor, open or totally-enclosed, is triply-protected against *physical damage, electrical breakdown* and *operating wear and tear*—still another reason designers use Tri-Clad motors, not only on the usual jobs which they do so economically, but on the *tough* jobs where unfailing performance is a must.

PROMPT DELIVERY

Especially important today, most models of Tri-Clad motors are available from stock at shipping points throughout the country. For more information send in the coupon below.

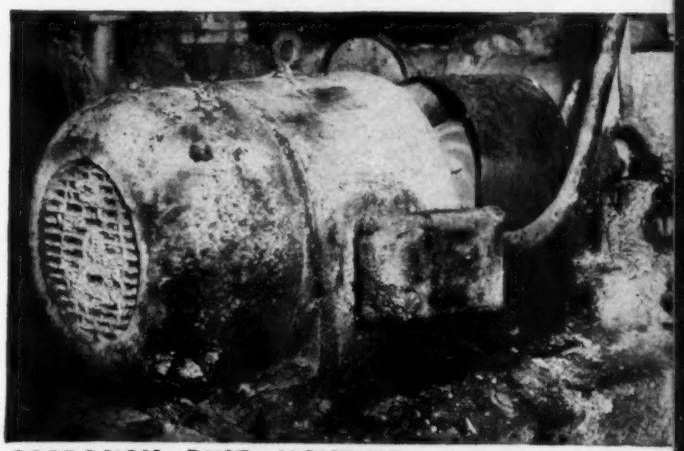


THE WIDEST VARIETY of standardized types and ratings in the motor industry are included in the Tri-Clad motor line. In addition to the examples shown in specific applications on these pages, here are a few other types which are used by designers everywhere:

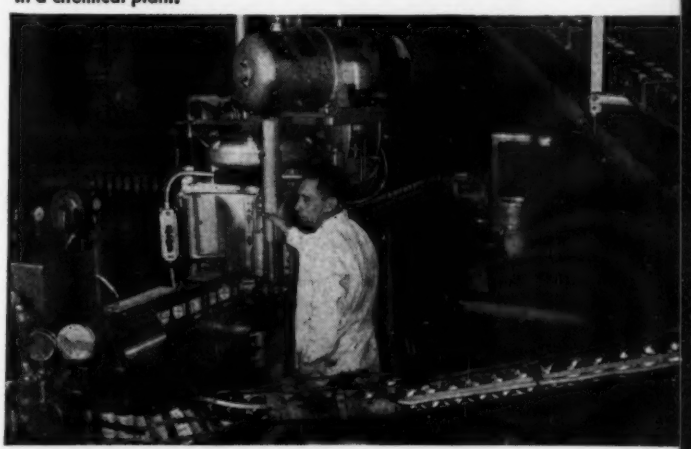
A TRI-CLAD WOUND-ROTOR MOTOR is used where extra-heavy starting ability is needed, and for adjustable-varying speed applications. Torque characteristics can be easily adjusted by changing external rotor resistance.

B COMPACT TRI-CLAD BRAKE MOTOR for use wherever you need an electrically operated spring-set brake. Equipped with Stearns magnetic brake. Most types of Tri-Clad motors are available with this brake.

C G-E SHELL-TYPE MOTOR DESIGNED for applications requiring a built-in motor. Especially suitable where compact, high-speed drive is required.



CORROSION, DUST, MOISTURE don't bother Tri-Clad totally-enclosed motors. This standard off-the-shelf 25-hp TEFC Tri-Clad motor runs pump 12 hours a day in soda ash crystallizing process in a chemical plant.



VARYING SPEEDS was one problem a designer had to solve in this can filling and sealing machine. The right solution was this 10-hp Type ACA Tri-Clad adjustable-speed a-c motor, rated 833 rpm to 2500 rpm. Speed can be adjusted by simply twisting a knob—at the motor or at a remote control station.

SEND FOR INFORMATION

General Electric Co., Section E-752-13, Schnectady 5, N. Y.

Send me the following literature:

☐ for reference only ☐ for planning an immediate project

☐ GEA-5464 New Tri-Clad Brake Motor

☐ GEA-4883 Tri-Clad ACA Adjustable-Speed Motors

☐ GEA-3580 Tri-Clad Open Dripproof Motors

☐ GEA-1437 Tri-Clad Gear-Motors

☐ GEZ-310 Instructor's Manual on new G-E motor course.

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TUTHILL MODEL CK PUMPS
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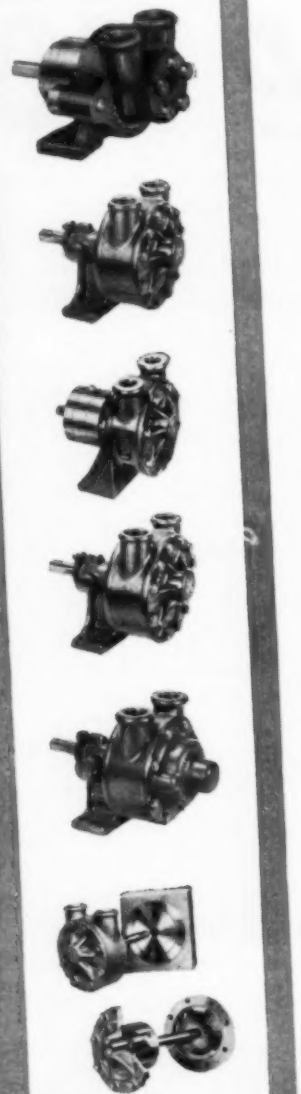
For Hydraulic Service

TUTHILL MODEL M PUMPS
For Coolant Service, with
automatic internal by-pass

TUTHILL MODEL R PUMPS
Automatic reversing pumps . . .
For Lubrication Service
(Model RC, non-relieving).
For Coolant Service (Model RM,
automatic internal by-pass).

TUTHILL MODELS S and SA PUMPS
All standard models are
available in stripped form for
building into the design of
your equipment.



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Tuthill positive displacement internal-gear rotary pumps are serving industry on machine tools, engines, speed reducers, compressors, hydraulic mechanisms, special machinery and oil-burning equipment.

Continued from page 25

Please send me three copies of the 20-page booklet "Know Your Component Symbols".

K. F. POTTER
Mechanical Engineer
American Hoist & Derrick Co.

Three copies have been sent to you. EDITOR'S NOTE: Copies of the second printing are still available on request.

We are unable to find a flow divider for a hydraulic system. Can you give us the name of a manufacturer of such a unit?

M. E. SANSERA
Central Engineering Dept.
Republic Steel Co.

Bendix Pacific Division of Bendix Aviation Corporation makes such a valve and describes it in their catalog No. 116. Great Lakes Mfg. Corp. of Cleveland, also offers a flow divider or equalizer.

Please send me tear sheets of the article entitled "The Efficiencies and What They Mean", which appeared on pages 57-59 of the August issue of APPLIED HYDRAULICS.

HENRY WESL
Detroit. 17, Mich.

A set of tear sheets of Part VII of the "Beginners Course in Basic Pneumatics", "The Efficiencies' and What They Mean", has been sent to you. Incidentally, the second half of the efficiencies appear in the September issue and close Section I of the Beginners' installments.

We have been somewhat embarrassed by inquiries that have been coming to us as a result of the review of our literature on Gaco Metal Insert Oil Seals in your May issue. Because of an arrangement with a well known American manufacturer (National Motor Bearing Co., Inc.,) we are precluded from making sales in the United States and Canada.

J. HESLOP
Office Manager
George Angus & Co., Ltd.
Newcastle Upon Tyne 6
England

We are sorry that this item was run without specifying just how American inquiries should be directed. The literature in question was forwarded us from our London office and was selected on the basis of interest to our readers.

Progress is as progress does

THE Eighth annual National Conference on Industrial Hydraulics has just finished its most successful meeting. To study the growth chart of this conference is a testementary evidence of the growth of the industry and of the importance of hydraulics and pneumatics in American industry.

Mere attendance does not tell the whole story. The avid attention paid to highly technical papers in crowded meeting rooms for two solid days, the spirited discussions of each paper both in the meeting rooms and in the corridors outside them gave importance to the whole subject.

The Illinois Institute of Technology and cooperating societies are to be congratulated on their farsightedness in having sponsored this Conference, back in 1945, when 110 men got together to listen to some papers on the little known subject of fluid mechanics. In the ensuing 8 years the Conference has grown till it has reached a registration of over 600 top engineers from all parts of the country and from virtually every industry. The attendance is truly a cross section of industrial activity because hydraulics plays a major role in practically every field of engineering.

There is only one thing lacking in the field of hydraulics. It is an active trade association. Unless such a trade association comes into being, progress in the adoption of hydraulics will be considerably slower. A trade association in this industry need not be the usual kind of sales promotional group but one which would do a job for the users. If no commercial displays are desired, perhaps a conference type of meeting—so successful in other industries—could be held each year.

The present high standards of the National Conference on Industrial Hydraulics must be maintained, but there should be, in our opinion, a place where the mutual problems of manufacturers and users can be discussed. Nothing should be permitted to lower the present Conference standards, but it must be recognized that there is an area below the pure science level wherein the future development and the widespread adoption of industrial hydraulics lies.

Assistance on maintenance problems and practical applications of components and circuits should be demonstrated to the tens of thousands of men in industry who have to deal with hydraulics in their every day operations. Like the Einstein theory, the present papers can be understood by only a relatively small percentage of those men in industry who are daily confronted with the practical use of hydraulics, either at the design or the maintenance level.

While it is the natural desire of the participants to keep the present Conference on the extremely high level these men must recognize the commercial and practical aspects as well. Industrial hydraulics as an industry is no longer in swaddling clothes. It is getting into young, vital and vibrant manhood. It is beginning to feel its strength and coming into the realization of its full potency. There is need and room for a well directed, well regulated commercial body and this magazine hopes that some group with the foresight equal to that of the Illinois Institute of Technology will take it upon itself to provide this industry with such a highly important vehicle.

Irving B. Baxter

PUBLISHER

FIG. 1. OPERATION of this vertical slotter is controlled from the pendant station and a lever at the side of the column which starts ram reciprocation.

Ingenuity of the design engineer by itself, will not sell a machine. The designer naturally has the user's needs in mind before he can set pencil to paper. He must then take advantage of all available power and control systems to combine them into a machine which will give

... the greatest profit to the user

By Earle W. Johnson

DEVELOPMENT of a production machine tool like the Rockford hydraulic slotter is carried out with these six major objectives, all having equal importance.

1. Sufficient size to handle a profitable range of work shapes and sizes.
2. Sufficient power to machine various materials at an efficient production rate.
3. Adjustable power and speed over the working cutting range.
4. Ease of operation, tooling and maintenance.
5. Low operating costs.
6. A competitive initial cost.

EARLE W. JOHNSON, Chief Development Engineer, Rockford Machine Tool Company, Rockford, Illinois

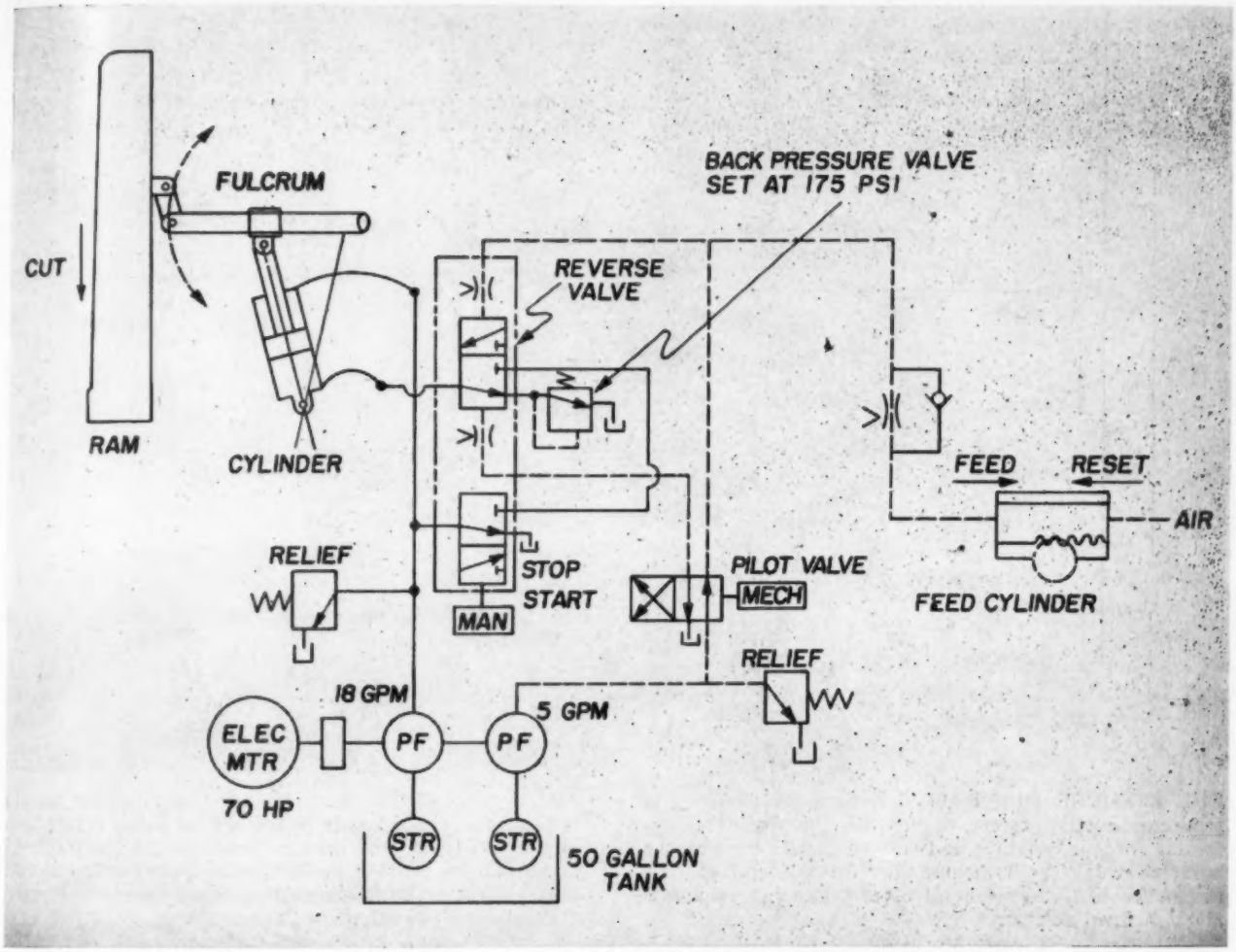


FIG. 2. A CONSTANT displacement double pump powers the ram, supplies pilot pressure to the reverse valve and pressure to the work feed cylinder. A differential circuit provides a return speed twice as fast as the cutting speed.

The designer lumps all these objectives into one aim: "Build a machine tool to give the greatest profit to the user". While this goal seems obvious, it is easy for the engineer who is busy solving problems of control, power and even appearance to meet several of the six objectives at the expense of the others.

Use of a Fulcrum Arm

On the Rockford hydraulic 12 and 20 inch slotters, a combination of mechanical, hydraulic and electrical control was decided on as the best means of meeting all six design objectives. The cutting ram uses a simple fulcrum arm which is hydraulically powered.

Tool speed, force and stroke must be varied on a slotter. However, once set for a given job, cutting speed and force must remain constant. Use of the patented hydraulically powered fulcrum arm meets these requirements.

Figure 2, the schematic of the ram power system, clearly shows the relationship of the ram, fulcrum arm and hydraulic cylinder. A constant delivery pump supplies oil to the hydraulic cylinder which is trunnion mounted. The piston rod of the cylinder is connected to a shoe which may be positioned at any point along the fulcrum arm. The fulcrum arm or lever has a fulcrum in the machine column. As the leverage is applied through the cylinder to the arm, the resulting force to the ram is a function of the oil pressure on the cylinder and the position of the shoe along the fulcrum arm. Conversely the speed of the ram is also a function of the position of the shoe and is inversely proportional to the cutting force at any point.

By means of this principle, which is illustrated in Figures 3 and 4, an infinite range of cutting speeds from approximately 25 to 100 fpm and a range of cutting force from 2800 to 12,000 pounds is available.

Electric Speed Selector

A small electric drive shifts the shoe on the fulcrum arm. The operator presses a button at the pendant station to operate this drive and a ram speed indicator finger, calibrated in feet per minute, moves and then

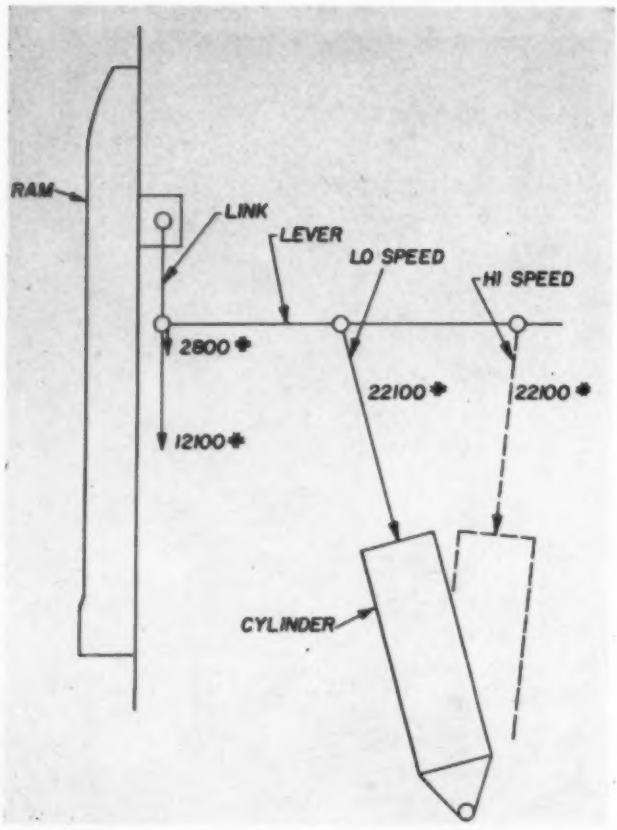


FIG. 3. FORCE DIAGRAM shows the maximum and minimum cutting forces exerted on the tool. The hydraulic force is constant and cutting force varies as the point at which the hydraulic force acts is shifted. The mechanics of the system involves balancing moments about a fixed fulcrum.

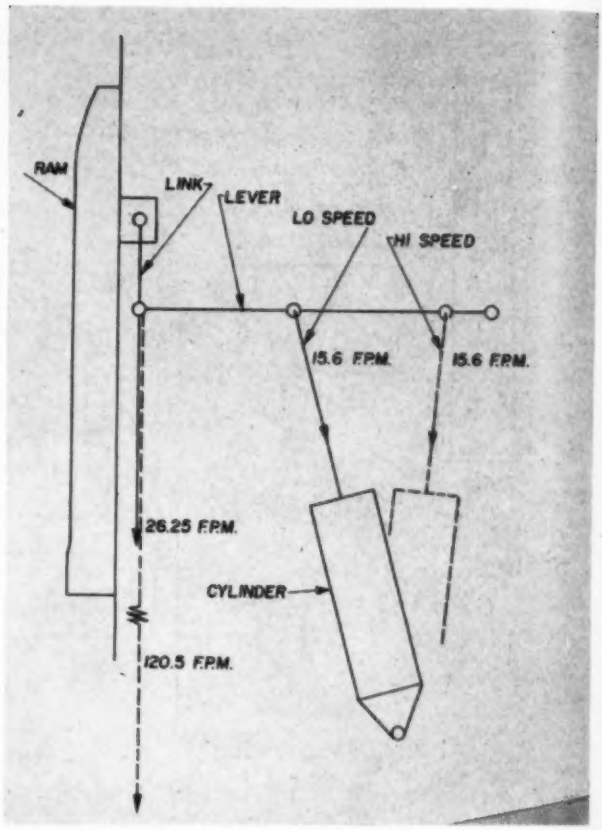


FIG. 4. A GRAPHICAL solution for ram cutting speeds is shown here. Hydraulic piston travel, being a function of pump delivery and area, is constant. As the point of application is shifted on the lever, ram cutting speed varies inversely with the cutting force shown in Figure 3. High and low ram speeds are shown.

stops when the push button is released. Limit switches protect the system from any possible overtravel. Cutting speed can be changed with the ram in motion which makes the selection of optimum speeds and feeds very convenient.

This fulcrum system makes posible variable speeds and forces while using a relatively simple oil system.

When you are designing control circuits . . .

You may find you'd like to have additional information on the electrical components. If technical data on the components listed will be helpful or if you want it for future reference, we'll be glad to see that you get it. Simply circle the appropriate numbers on the Readers Service Card in this issue.

Electrical Equipment

Start Stop Switches 242
("Push button" switches, panel assemblies)

Timers, Electric .... 243 Motors 246
Solenoids ..... 244 Pressure Switches.. 247
Limit Switches ..... 245 Relays 248

A constant volume pump is used and flow control valves are not necessary. This system is more positive, less costly and easier to maintain than either a fully mechanical or hydraulic design. System pressure is limited to approximately 1000 psi by the relief valve. Variable speed is accomplished without bypassing any oil through the relief valve to make the machine very efficient from a horsepower standpoint.

Pilot Valve for Stroke Control

To obtain stroke control and ram reversal, a trip bar moves with the ram. A trip dog, integral with the bar, actuates operating cams which are geared to the rotary pilot valve. Vertical adjustment is by means of an adjusting screw. The position of the entire trip assembly can be varied vertically by means of adjusting nuts. Stroke length can be adjusted while the ram is in motion.

The circuit drawing, Figure 2, shows the use of a differential piping arrangement. On the cutting stroke pressure oil is exerted on the rod side of the cylinder. The cylinder moves down and oil from the head end returns to tank by way of the reverse valve and back pressure valve. Setting the back pressure at 175 psi assures smooth action of the cutting ram. Without a

back pressure the ram would lunge or jerk when the tool finished its cut or if for some other reason the cutting load was removed.

When the trip dog shifts the pilot valve to direct pilot pressure to reverse the main valve, pressure oil from the main pump is directed to both the head and rod ends of the cylinder. Because of the area differential, the piston rod is driven upward to return the ram. During the cut, the rod is in tension and oil acts on the effective area of the cylinder around the rod. This area is twice the rod area; therefore, during the return which is differential, the pump acts only on the rod area to give a return speed of twice the cutting speed.

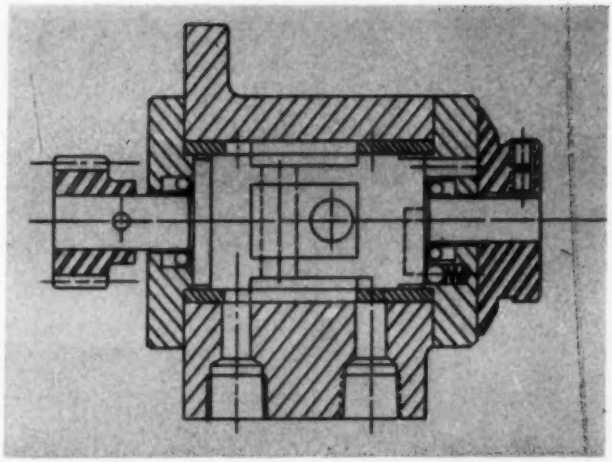


FIG. 6. FOR STROKE reversal a trip dog actuates operating cams to rotate the pinion on the end of the rotary pilot valve.

Throttling Grooves Reduce Shock

The stop-start and reverse valves are spool type valves built into one housing. A lever is located on both sides of the machine column, convenient to the operator for shifting the stop-start valve. Pilot pressure is used to shift the reverse valve.

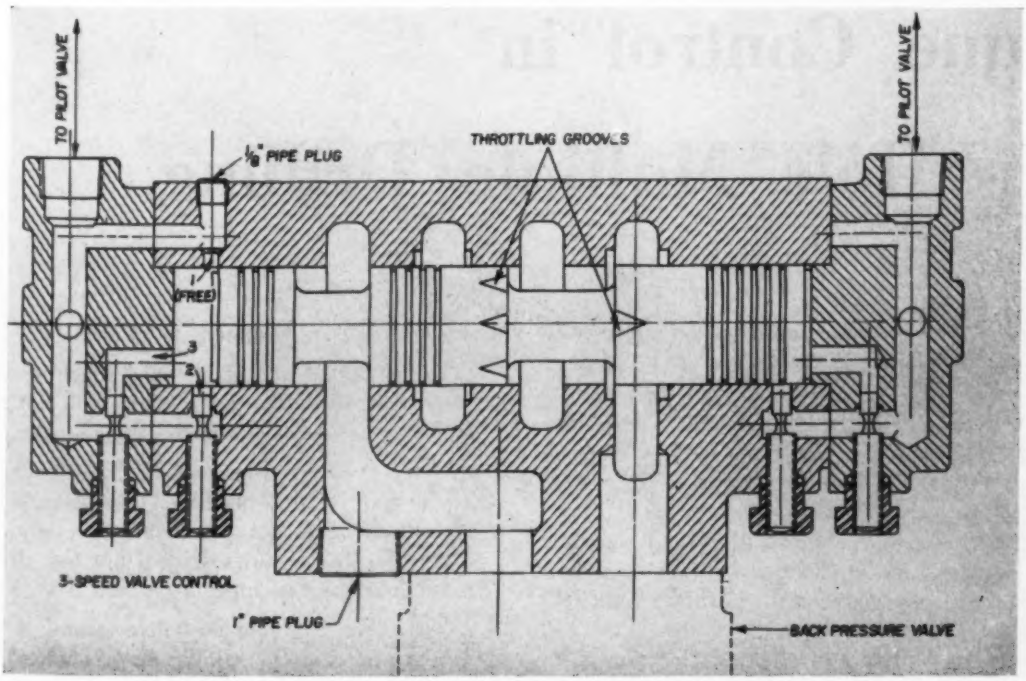
Throttling grooves on the valve spool and built in needle valves minimize shock of reversal. Figure 5, illustrates the valve design. The size of the orifices are critical and are established by experience.

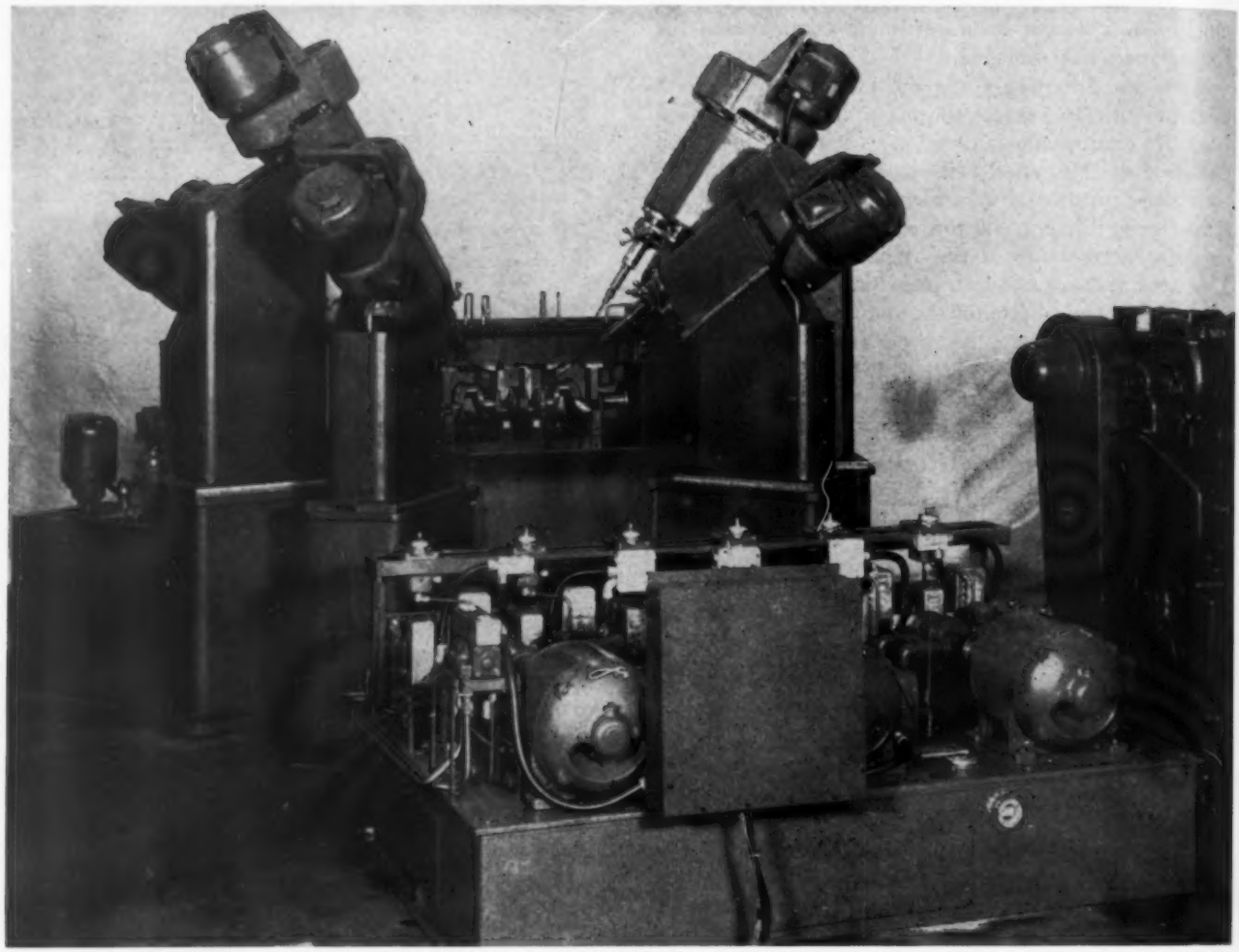
Powering the table feeds for cross, longitudinal and rotary motion is accomplished by the one cylinder, working through suitable gear trains, seen in Figure 2. The pilot pump supplies oil to the feed cylinder. The feed circuit is arranged with a restriction so that the reverse valve operates first. Sufficient pressure is available to assure a fast and snappy feed before the tool enters the cut. Enough overtravel is allowed on the stroke to provide time for the feed to take place. This can usually be done in less than one inch.

A one horsepower electric motor provides rapid traverse in each of the three feed directions. Limit switches protect against overtravel.

To give the metal working industries an efficient slotter, development of the machine made use of basic mechanics and took advantage of the high forces available from a compact hydraulic power system.

FIG. 5. SHOCK of valve reversal is minimized by the use of spool throttling grooves and built in needle valves in the ram reversing valve. Orifice diameters are determined by trial.





SIX FEED CIRCUITS are used on this crankshaft drilling machine. Each of the three, 1200 rpm, 3 hp electric motors drives a double pump to supply oil pressure for two of the feed circuits. The hydraulic power unit is located behind the machine, readily accessible for maintenance.

Torque Control in Deep Hole Multiple Drilling

SMALL diameter, deep holes need not be a headache to the machine shop. Designed by H. E. Farmer Engineering Co., Detroit, this crankshaft drilling machine has a hydraulic feed circuit which is tied into an electronic device that reverses the feed cylinder at any point in the stroke if builtup chips or drill wear cause an increase in drilling torque.

The torque limit is adjustable and when the torque exceeds the setting of the control device, the feed cylinders are actuated to raise the drills. Chips will be washed away by the coolant,. and the head will move forward to complete the drilling. Ample warning for drill replacement is given.

Each drill on the six headed machine is independently controlled. The work clamp will not release until all six heads have completed their stroke.

Six 5/16 inch diameter, 5 3/16 inch deep holes are drilled on this machine. Operating at 80 percent efficiency, 21 shafts per hour can be drilled. With more than 5000 shafts drilled, not one drill had been broken on this machine.

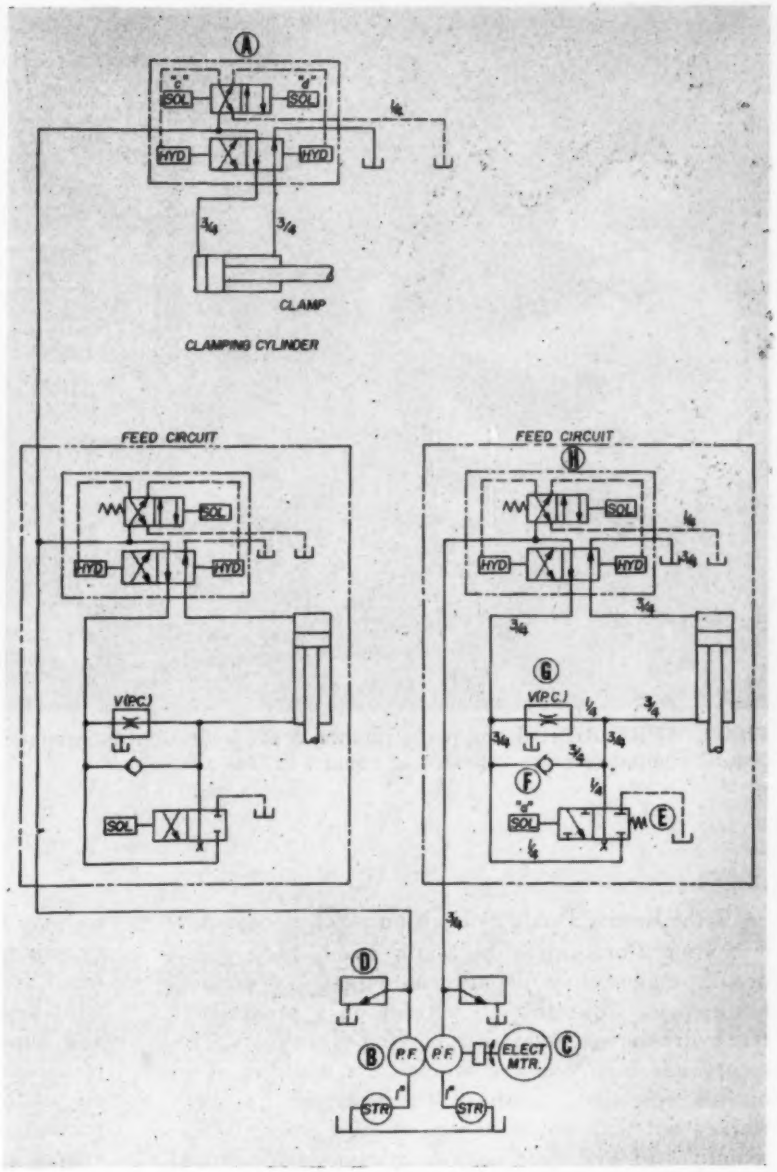
The torque control unit detects and is actuated by minute increases in spindle motor current.

HERE ARE TWO of the six identical drill feed circuits and the work clamp circuit. When the machine is idle all solenoids are deenergized and pump volume is returned to tank through D at its pressure setting.

To start operation, solenoids "a" and "b" are energized to direct flow through H into the head end of the feed cylinder. For rapid advance oil discharges through E and H to tank. When a limit switch is contacted, solenoid "a" is deenergized and discharge is through G and H to tank for feed. The rate of feed is determined by the setting of Valve G. At the end of stroke a limit switch is contacted to deenergize solenoid "b." Flow is now directed through H and F into the rod end of the cylinder for rapid return. Discharge is through valve H to tank.

The purpose of D is to control maximum working pressure and provide overload protection for pump and motor.

Valve A is used for clamping the part on the machine. Pressure is taken from any one pump on the hydraulic unit. When solenoid "c" is energized momentarily, the part is released. Momentarily energized solenoid "d" clamps the part.



ELECTRIC CONTROL components for automatic valve actuation are mounted in the panel at the right. The six electronic torque control units are also on the panel. The torque meters seen on the machine are easily adjusted to cause drill retraction at a given torque load. Drill breakage caused by chips or wear is eliminated.

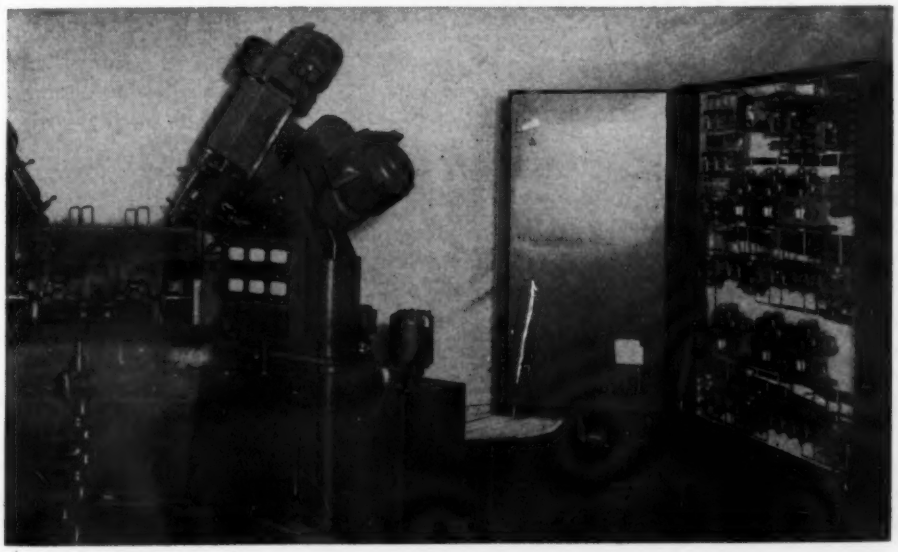


FIG. 1. WORK BENCH and parts cabinet in the hydraulic maintenance shop at the Bendix Products plant. All hydraulic components are repaired or rebuilt in this shop.

AT the Bendix Products Division plant, Bendix Aviation Corporation at South Bend, Ind., a hydraulic maintenance department, largely self-trained, has reduced downtime 75 percent on approximately 600 hydraulic machines over a period of six years. This record has been achieved without the addition of an outside specialist; much of the program has been worked out with the assistance of field service representatives of hydraulic equipment manufacturers and the suppliers of hydraulic oils and packings. The "plus" factor which, more than any other, has made the hydraulic maintenance program tick, was the enthusiasm and the unusually fine spirit of cooperation between the supervision personnel and the maintenance crews.

Assembling Case Histories

A beginning was made on hydraulic maintenance in this plant about 15 years ago, when the first hydraulically operated machines—internal grinders—were put in service. Trained pipefitters and electricians who took care of other maintenance work were available. None had any previous experience with hydraulic circuits. Management approved of the request of the pipefitters to tackle the hydraulic service problems.

First one, then a second member of this volunteer group, was sent to the Vickers training school and to the General Motors short course for hydraulic maintenance. In turn, each man accepted received the same training. Apprentices who showed particular aptitude or expressed special interest were transferred to the small hydraulic service group.

At first, considerable reliance on the manufacturers and suppliers of hydraulically operated equipment, components and services was necessary. Gradually as circuit components and their vagaries became familiar, preventive maintenance procedures were set up and simple, easy to follow service records were worked out.

At first progress was slow as the men learned on the job. Circuits were traced out, components disassembled, studied and reassembled, case histories of irregular operation and their remedies were assimilated. As new hydraulic equipment came into the plant, the hydraulic maintenance group worked with the installation crews and with the suppliers' service men. They secured and kept circuit, assembly and detail prints in their own files. While the design and production engineering departments in the plant were cooperative, it was sometimes necessary to secure additional prints, operation and trouble shooting sheets or charts from manufacturer or supplier concerned. At the present time a very complete file of manufacturer's literature is maintained for the routine use of the hydraulics group.

Training Program

As more and more hydraulically operated machines came into the shops, the hydraulics maintenance group set up a training program for apprentices. Aside from job training, apprentices attended a "downtown" eve-

The Bendix Story On Hydraulic Maintenance

Pipefitters and electricians need special training and experience to properly maintain hydraulically powered machines. They can readily be trained by taking advantage of courses held at industrial plants and vocational schools. Once the construction and operation of hydraulic components are understood, good service and machine records along with an adequate stock of spare parts keeps oil powered machines on the production line.

ning school sponsored by the Studebaker Corporation and set up jointly by the union and management. The school, approved by the State Board for Vocational Education, offers a number of courses in addition to the practical shop hydraulic course. Each apprentice trained by the maintenance group is a graduate of this school. Progress made by the apprentices is continuously checked by both the general foreman and the supervisor of apprentice training.

The hydraulic maintenance section is in direct charge of general foreman Les Culp. The section consists of ten trained hydraulic service men and two apprentices. Six men, under Fred Krueger, hydraulic maintenance foreman, and the two apprentices are on the first shift, two men are on each of the second and third shifts.

Apprentices act as helpers for the service men on all types of hydraulic systems throughout the shops. Ap-

FIG. 2. PARTS CABINETS, specially built for an adequate stock of parts and materials as well as complete components and assemblies, are designed for maximum utility and convenience. All members of the maintenance crew are trained to handle any pump or valve repair work.

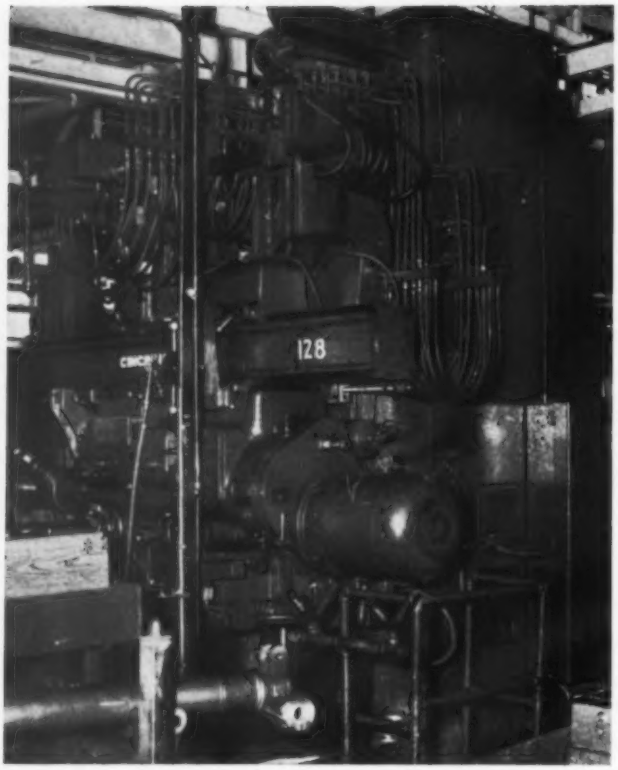
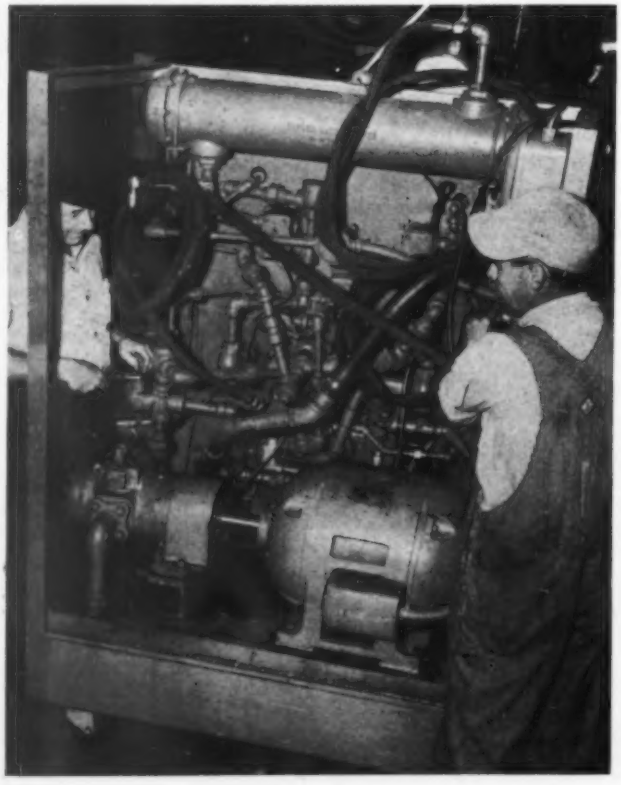


FIG. 3. THE HYDRAULIC control system is shown on this rear view of a Cincinnati mill. This is one of over 600 machines of all types that are hydraulically operated and controlled in the Bendix shops.

FIG. 4. THIS PORTABLE unit is used for testing hydraulic components of aircraft landing gear at pressures up to 3000 psi.



prentices, in addition to their specific duties for which they are responsible, also receive training in preventive maintenance, trouble shooting and other work.

Plan of Operation

As the hydraulic maintenance crew gradually shook down their procedure of operation, the work divided into four general functions: (1) preventive maintenance; (2) trouble shooting; (3) service; and (4) rebuilding and repair.

Preventive maintenance work is always being carried out by the entire crew, including the apprentices. The specific responsibility of the apprentices is to take care of the maintenance of oil levels or makeup oil requirements for all hydraulic machines. The shops are equipped with two "chore boy" hand trucks, on which light, medium and heavy grades of high quality hydraulic oil is carried in drums. Portable continuous purifier filter units of fullers' earth type are used for the care of oil in some of the heavy machines. Apprentices are progressively trained to observe and report irregular operation due to malfunctioning of hydraulic components.

The regular maintenance personnel systematically check machine and cycle operations for balanced circuits, making sure that proper, accurate production cycles are maintained. Adjustments or replacements of individual components are made when necessary or when called for on each machine record.

An important part of the preventive maintenance program is the realistic approach to the leakage control problem. Procedures to run down the cause of any leak and the corrective action to take, are well established.

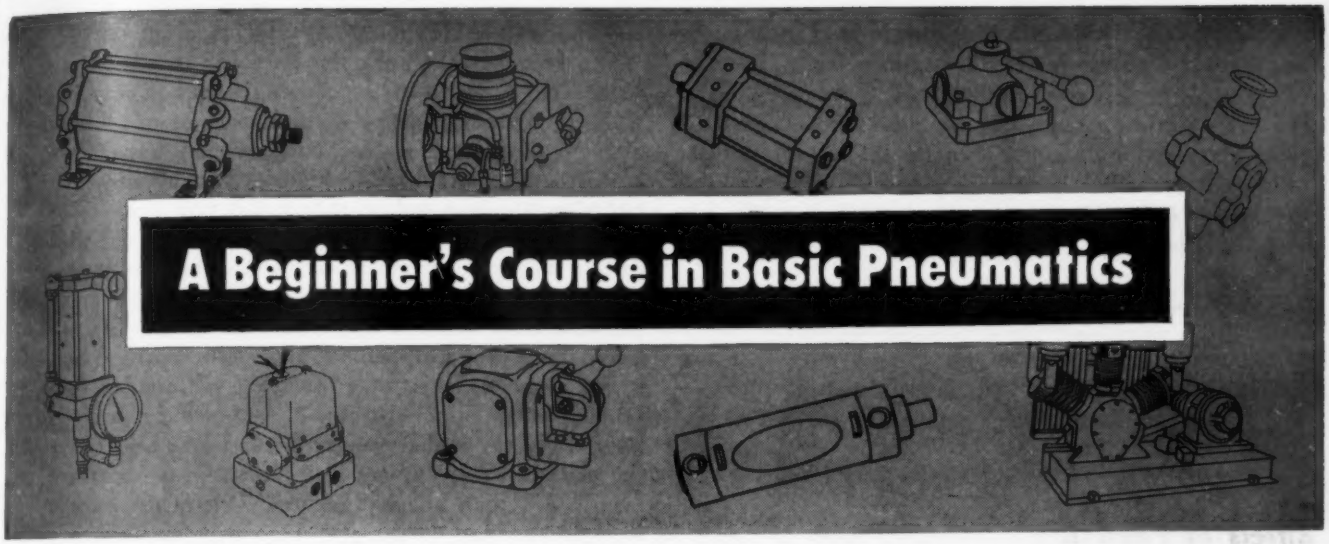
Recommended grades of hydraulic oil were used from the beginning of the program. Field representatives of a leading oil company were very helpful in setting up a leakage control procedure. Initial trouble was experienced with leaking packings, particularly rotating and reciprocating shaft seals because of the variety of packing types used on original installations and the modifications of hydraulic systems to different duty cycles. However, the field service personnel of one packing manufacturer was especially helpful in staying with the troublesome jobs, particularly the bad "leakers" until the regular maintenance men were able to come up with satisfactory solutions.

Visual Index for Each Machine

The hydraulically operated machines at the Bendix shops at South Bend now number approximately 600; divided between the two main shops—the Brake "side" and the Aviation "side". Machines are numbered and visual record index cards for each machine are kept by number, section or location and type of machine or operation.

Since the hydraulic maintenance section operates with considerable independence, they maintain a small shop area, centrally located, where work benches, tools and a small but adequate stock of pump and valve parts, fittings, tube and hose assemblies are kept. In this area the complete file of manufacturers' prints

Continued on page 94



Section II

The Distribution System

Part I

Introduction

THE four basic components of a pneumatic system are; (1) the supply or power source (compressor, control and auxiliary devices); (2) work or power devices (cylinders, diaphragms, chambers, air clutches and chucks, etc.); (3) control devices (valves, flow and pressure control and auxiliary valves); and (4) distribution lines.

We will treat each of these components or groups of components in turn, beginning with distribution lines.

Distribution lines include all main line and branch metal and rubber lines which confine and carry compressed air from the receiver or storage pressure tank to the point or points of use.

Well designed distribution systems permit efficient compressors to supply cylinders and other work components with the pressure intended for by the designer and at which the maximum production output of the work component can be secured.

However, distribution systems must be designed for the best results. It is important that the pressure drop between the receiver and the point of use be kept at a minimum and the net delivered pressure be within the most efficient operating pressure range of the work component. It must be remembered that any loss in pressure in the distribution lines is irrecoverable loss.

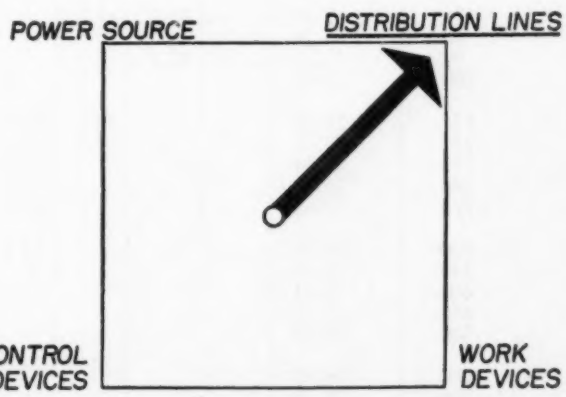


FIG. 1. The four basic components of a pneumatic system.

Requests for previous installments of the Beginners' Course in Basic Pneumatics . . .

We can continue to supply tearsheets for all back issues containing Section I except February, 1952. Our supply of other issues will soon be depleted so we suggest you save your copies. The entire series will be reprinted when completed.

There are two principal sources of pressure drop in a compressed air distribution system; (1) friction and (2) leaks.

Effects of Friction

A great deal of research work has been done on the effects of flow of fluids in pipe. The effects of friction are well understood and can be computed very accurately. The coefficient of friction depends on the diameter of the line, the velocity of flow and the density and viscosity of the fluid. For compressed air work the most important of these factors is the diameter of the line. The velocity of flow depends a good deal on the pressure and the diameter of the line. The density and viscosity of air should not vary much.

For practical air work the effect of friction is to reduce the pressure of the air delivered. Convenient tables give losses of air pressure in psi in nominal pipe diameters for considerable ranges of cubic feet of air both free and compressed. Figures 2 and 3 are such tables in 100 psig and 80 psig initial pressure.

The "Compressed Air Handbook" states, as the first rule in planning a compressed air distribution system, that "pipe sizes should be large enough so that the pressure drop between the receiver and the point of use will not exceed 10 percent of the initial pressure."*

For example, let us take a compressed air distribution system in which 10 cfm of 100 psig compressed air is delivered at the receiver intake to the line. Enter the table in Figure 2. On line 10.24 cfm the pressure loss in a 1 inch line is 17.8 psi. This is too high a loss, so the next larger size 1¼ inch, which has a pressure loss of 4.14 psi, is selected. This is well within the 10 percent of the initial pressure.

Or take another example—a system in which 50 cfm of 80 psig compressed air is delivered. Enter

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* *Other general rules are: use loop system wherever possible to provide two-way distribution to the point of greatest air demand; long distribution lines should have adequate receivers near far ends or at points of heavy use; provide frequent outlets on each header or main branch lines or hose connections; and arrange slope of all piping toward one or more moisture traps.*

FIG. 2. Loss of air pressure due to friction, 100 psig initial pressure

Cu. Ft. of Free Air Per Minute	Equivalent Cu. Ft. of Compressed Air Per Minute	NOMINAL DIAMETER IN INCHES											
		½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5
10	1.28	6.50	.99	.28	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	2.56	25.9	3.90	1.11	.25	.11	.....	.....	.....	.....	.....	.....	.....
30	3.84	58.5	9.01	2.51	.57	.26	.....	.....	.....	.....	.....	.....	.....
40	5.12	.....	16.0	4.45	1.03	.46	.....	.....	.....	.....	.....	.....	.....
50	6.41	.....	25.1	6.96	1.61	.71	.19	.....	.....	.....	.....	.....	.....
60	7.68	.....	36.2	10.0	2.32	1.02	.28	.....	.....	.....	.....	.....	.....
70	8.96	.....	49.3	13.7	3.16	1.40	.37	.....	.....	.....	.....	.....	.....
80	10.24	.....	64.5	17.8	4.14	1.83	.49	.19	.....	.....	.....	.....	.....
90	11.52	.....	82.8	22.6	5.23	2.32	.62	.24	.....	.....	.....	.....	.....
100	12.81	.....	.....	27.9	6.47	2.86	.77	.30	.....	.....	.....	.....	.....
125	15.82	.....	.....	48.6	10.2	4.49	1.19	.46	.....	.....	.....	.....	.....
150	19.23	.....	.....	62.8	14.6	6.43	1.72	.66	.21	.....	.....	.....	.....
175	22.40	.....	.....	.....	19.8	8.72	2.36	.91	.28	.....	.....	.....	.....
200	25.62	.....	.....	.....	25.9	11.4	3.06	1.19	.37	.17	.....	.....	.....
250	31.64	.....	.....	.....	40.4	17.9	4.78	1.85	.58	.27	.....	.....	.....
300	38.44	.....	.....	.....	58.2	25.8	6.85	2.67	.84	.39	.20	.....	.....
350	44.80	.....	.....	.....	.....	35.1	9.36	3.64	1.14	.53	.27	.....	.....
400	51.24	.....	.....	.....	.....	45.8	12.1	4.75	1.50	.69	.35	.19	.....
450	57.65	.....	.....	.....	.....	58.0	15.4	5.98	1.89	.88	.46	.25	.....
500	63.28	.....	.....	.....	.....	71.6	19.2	7.42	2.34	1.09	.55	.30	.....
600	76.88	.....	.....	.....	.....	.....	27.6	10.7	3.36	1.56	.79	.44	.....
700	89.60	.....	.....	.....	.....	.....	37.7	14.5	4.55	2.13	1.09	.59	.....
800	102.5	.....	.....	.....	.....	.....	49.0	19.0	5.89	2.77	1.42	.78	.....
900	115.3	.....	.....	.....	.....	.....	62.3	24.1	7.6	3.51	1.80	.99	.....
1,000	126.6	.....	.....	.....	.....	.....	76.9	29.8	9.3	4.35	2.21	1.22	.....

table in Figure 3. On line 54.2 cfm the pressure loss in a 2 inch line is 11.4 psi. This is greater than the initial pressure, so a selection of the 2½ inch line, which has a pressure loss of 4.42 psi, is made.

The same procedure should be used for divided main and branch lines.

The ells, tees, valves and fittings also offer resistance to the flow of air. The total pressure drop of the entire system, the addition of pressure drops of all pipe and fittings must not exceed 10 percent of the initial pressure. This is an arbitrary figure set up as a general safeguard. Actually, any compressed air distribution system should be designed to a minimum pressure drop.

Leaks

Leaks are one of the principal causes of pressure drop in the distribution system. Unlike hydraulic lines where leaks are very apparent, air lines may leak undetected. Low pressure may seriously affect production. For example, if the pressure at a pneumatic tool falls from 90 psig to 70 psig, the production output of that tool may drop as much as 35 percent. An air motor, designed to operate at 90 psig, will lose 25 percent of its capacity if pressure drop in the system permits only 70 psig to be delivered to the air motor.

The detection and stopping of leaks is an important factor in the efficient operation of a compressed air system. Plant maintenance departments have developed many simple checks for leaks. Common ones are the use of lighted candles or the application of soapy water on suspected joints. An Illinois manufacturer puts essence of peppermint at regular intervals into the system before regular inspections for leaks. The use of sensitive whistles or anemometers have also been used to advantage. A regular monthly check for leaks by a trained maintenance man is strongly recommended.

Even small leaks may be costly. Figure 4 illustrates the cost of air line leaks per month.

The next installment will give examples on how to figure pipe sizes for air distribution systems.

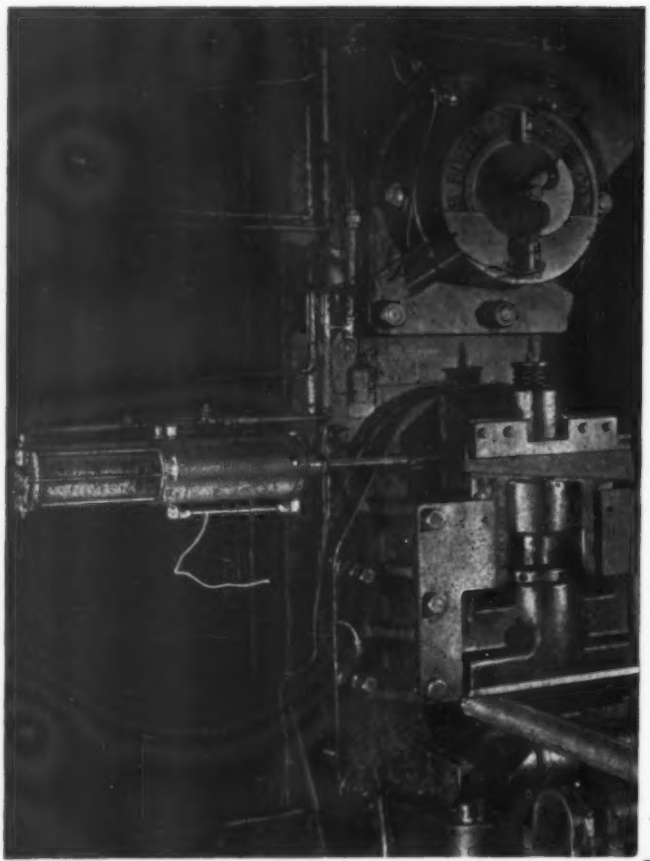
Size of Opening (inches)	*Air Lost (cfm/month at 100 psig; nozzle efficiency .65)*	*Cost of Air Lost (0.07/1000 cu ft)*
3/8	6,671,890	$467.03
1/4	2,920,840	204.46
1/8	740,210	51.80
1/16	182,272	12.75
1/32	45,508	3.19

FIG. 4. Cost of air line leaks.

FIG. 3. Loss of air pressure due to friction, 80 psig initial pressure

Cu. Ft. of Free Air Per Minute	Equivalent Cu. Ft. of Compressed Air Per Minute	NOMINAL DIAMETER IN INCHES											
		½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5
10	1.55	7.90	1.21	.34	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	3.10	31.4	4.72	1.35	.31	.....	.....	.....	.....	.....	.....	.....	.....
30	4.65	70.8	10.9	3.05	.69	.31	.....	.....	.....	.....	.....	.....	.....
40	6.20	.....	19.5	5.40	1.25	.56	.....	.....	.....	.....	.....	.....	.....
50	7.74	.....	30.5	8.45	1.96	.87	.....	.....	.....	.....	.....	.....	.....
60	9.29	.....	43.8	12.16	2.82	1.24	.34	.....	.....	.....	.....	.....	.....
70	10.82	.....	59.8	16.6	3.84	1.70	.45	.....	.....	.....	.....	.....	.....
80	12.40	.....	78.2	21.6	5.03	2.22	.59	.....	.....	.....	.....	.....	.....
90	13.95	.....	.....	27.4	6.35	2.82	.75	.....	.....	.....	.....	.....	.....
100	15.5	.....	.....	33.8	7.85	3.47	.93	.36	.....	.....	.....	.....	.....
125	19.4	.....	.....	46.2	12.4	5.45	1.44	.56	.....	.....	.....	.....	.....
150	23.2	.....	.....	76.2	17.7	7.82	2.08	.81	.....	.....	.....	.....	.....
175	27.2	.....	.....	.....	24.8	10.6	2.87	1.10	.....	.....	.....	.....	.....
200	31.0	.....	.....	.....	31.4	13.9	3.72	1.44	.45	.....	.....	.....	.....
250	38.7	.....	.....	.....	49.0	21.7	5.82	2.25	.70	.33	.....	.....	.....
300	46.5	.....	.....	.....	70.6	31.2	8.35	3.24	1.03	.47	.....	.....	.....
350	54.2	.....	.....	.....	.....	42.5	11.4	4.42	1.39	.65	.33	.....	.....
400	62.0	.....	.....	.....	.....	55.5	14.7	5.76	1.82	.84	.42	.....	.....
450	69.7	.....	.....	.....	.....	.....	18.7	7.25	2.29	1.06	.55	.....	.....
500	77.4	.....	.....	.....	.....	.....	23.3	9.0	2.84	1.32	.67	.30	.....
600	92.9	.....	.....	.....	.....	.....	33.4	12.9	4.08	1.89	.96	.53	.....
700	108.2	.....	.....	.....	.....	.....	45.7	17.6	5.52	2.58	1.32	.72	.....
800	124.0	.....	.....	.....	.....	.....	59.3	23.1	7.15	3.36	1.72	.95	.....
900	139.5	.....	.....	.....	.....	.....	.....	29.2	9.17	4.26	2.18	1.19	.....
1,000	155	.....	.....	.....	.....	.....	.....	36.1	11.3	5.27	2.68	1.48	.....

Air Powered Oi



IF the force required to move a machine member or clamp a part can be developed with shop air pressure of 80 psi on a cylinder of reasonable diameter, the designer will give first consideration to the use of air power. He has the advantages of fast action, the simplicity of a low pressure system and the economy of using available compressor capacity.

However, for many applications the use of air alone results in a less even, jerky action which can make air feeds unreliable. To solve the problem of control, the designer can combine the use of air and oil. Air will power the system and oil will regulate the speed to maintain smooth, uniform travel.

There are several standard cylinder designs, using the combination of air and oil. The circuits shown here use an integral unit having an air piston and a hydraulic piston mounted on the same rod. The thrust or pull of the rod is obtained by means of the air cylinder, controlled by valves. The two chambers in the hydraulic cylinder are connected externally in a self contained circuit. An adjustable speed control valve in this circuit, by regulating the flow of oil, controls the speed of the rod stroke.

Rapid return is made possible by a check valve in the hydraulic piston, permitting unobstructed oil flow

BILLET SHEAR uses an air-oil cylinder to power the stripper hold-down for clamping bar stock. Its action is controlled by a cam operated air valve which automatically reverses the piston stroke.

Photographs courtesy Logansport Machine Co., Inc.

SPECIAL LATHE for machining a hard bronze weld bead uses an air-oil cylinder for powering and feeding the cutter. The cylinder engages cams which feed rough and finish tools into the work in a single operation. The automatic cycle is regulated by electric solenoid operated air valves.

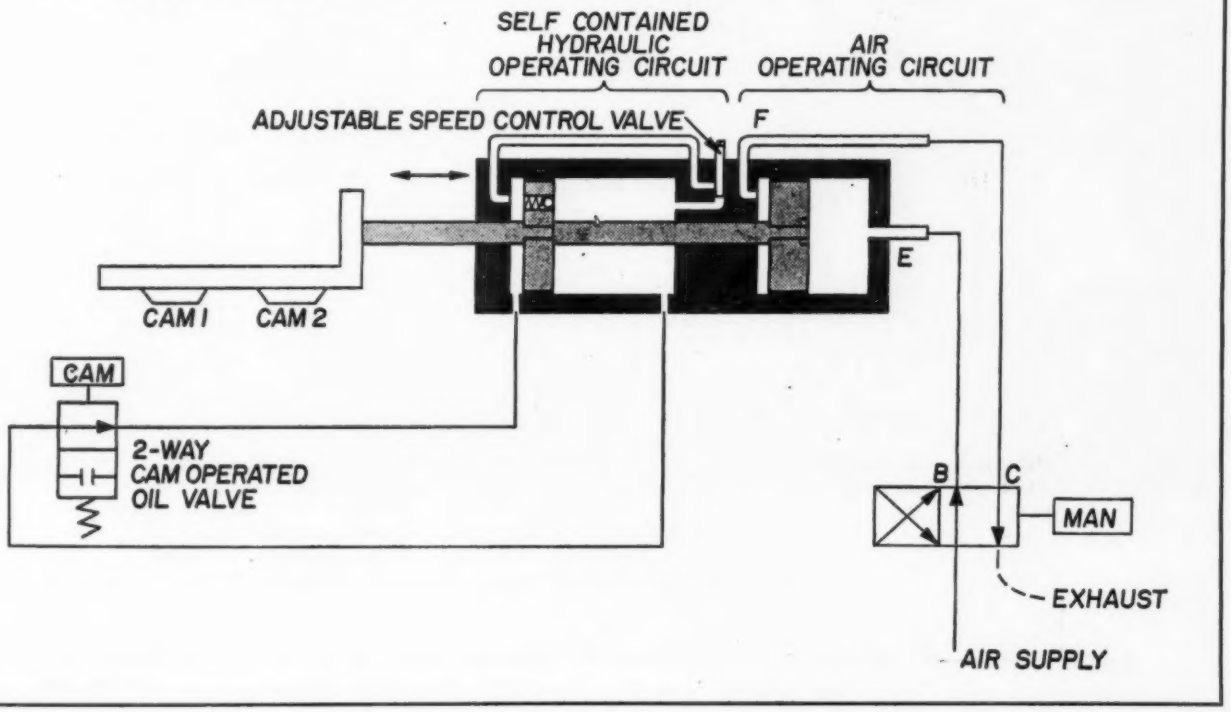
red, Oil Controlled Cylinders

smooths machine production

on the return stroke. Controlled feed in both directions can be had by omitting the check valve. Skip-feed can be obtained through the use of cam valves applied externally in the hydraulic circuit.

A second method of combining the advantages of air power and oil control uses a conventional air cylinder tied-in with a separate oil dash pot for control of feed.

A Typical Feed Circuit



FEED circuit using an air powered, oil controlled cylinder. Piston speed is controlled by a cam operated valve in the hydraulic circuit. This valve is actuated by adjustable cams bolted to the underside of the moving machine table.

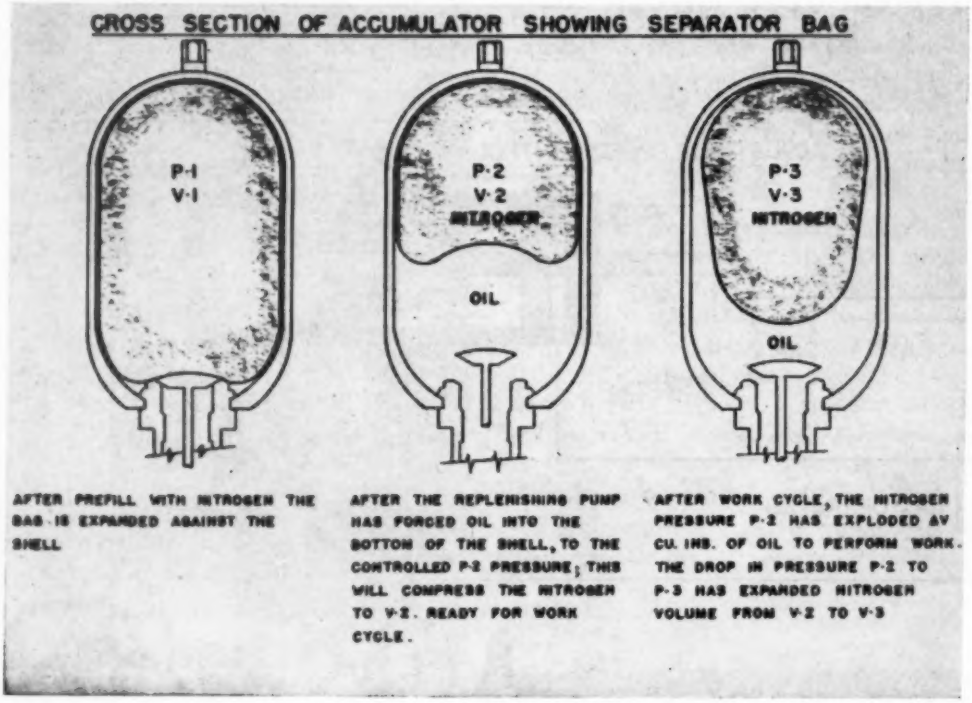
The air circuit is controlled by a foot operated 4-way air valve of the latching type. In operation, the pedal is pressed, latching the valve to direct air from valve port B to cylinder port E, moving the machine table forward. Oil is forced from valve port H and moves freely through the 2-way cam operated hydraulic valve.

The movement of the machine table is rapid until cam 1 strikes the cam roller on the hydraulic valve. Then the valve piston is depressed to a position which prevents free flow of the oil. As a result, the oil must flow through the speed control needle (pre-set to the desired speed), and piston rod and table must move at a controlled speed until the cam has passed the roller. When this point is reached, the valve piston automatically moves up to its former position, and the regulating oil again flows freely through the hydraulic valve to permit a rapid feed. This entire cycle is repeated as cam 2 crosses over the cam roller.

The latch of the air valve is released by pressing the pedal a second time. Air is directed from valve port C to cylinder port F to retract the piston rod and machine table. The cycle can also be stopped at any point on the forward stroke and the machine table returned to its starting position by simply pressing the foot valve pedal again.

For Your Pneumatic and Hydraulic Design Notebook

How to Select a Hydropneumatic Accumulator


CROSS SECTION OF ACCUMULATOR SHOWING SEPARATOR BAG
P-1
V-1
P-2
V-2
NITROGEN
OIL
P-3
V-3
NITROGEN
OIL
AFTER PREFILL WITH NITROGEN THE BAG IS EXPANDED AGAINST THE SHELL
AFTER THE REPLENISHING PUMP HAS FORCED OIL INTO THE BOTTOM OF THE SHELL, TO THE CONTROLLED P-2 PRESSURE; THIS WILL COMPRESS THE NITROGEN TO V-2. READY FOR WORK CYCLE.
AFTER WORK CYCLE, THE NITROGEN PRESSURE P-2 HAS EXPLODED ΔV CU. INS. OF OIL TO PERFORM WORK. THE DROP IN PRESSURE P-2 TO P-3 HAS EXPANDED NITROGEN VOLUME FROM V-2 TO V-3

This cross-sectional drawing shows you what happens inside an accumulator at gas prefill, oil charge and oil discharge conditions. Pressures and volumes are related by Boyle's Law which states that the gas pressure will increase as the volume of the gas is decreased as long as the temperature is constant. The relationship is such that multiplying the pressure by the volume of gas will result in a constant for all positions of the accumulator bag.

Putting all this in an equation, we have:

$$P_1V_1 = P_2V_2 = P_3V_3$$

The usual problem confronting the designer is the selection of an accumulator of the proper size. Before he can start his computation he must first determine:

1. How much oil per cycle must be supplied by the accumulator to the cylinder on the machine.
2. Because oil pressure delivered from an accumulator is not a constant—it varies from P_3 to P_2, the work which the machine performs must be completed in this pressure range. The designer must know the minimum oil pressure for his job.

To illustrate the selection of an accumulator, let us assume a press design having the following conditions.

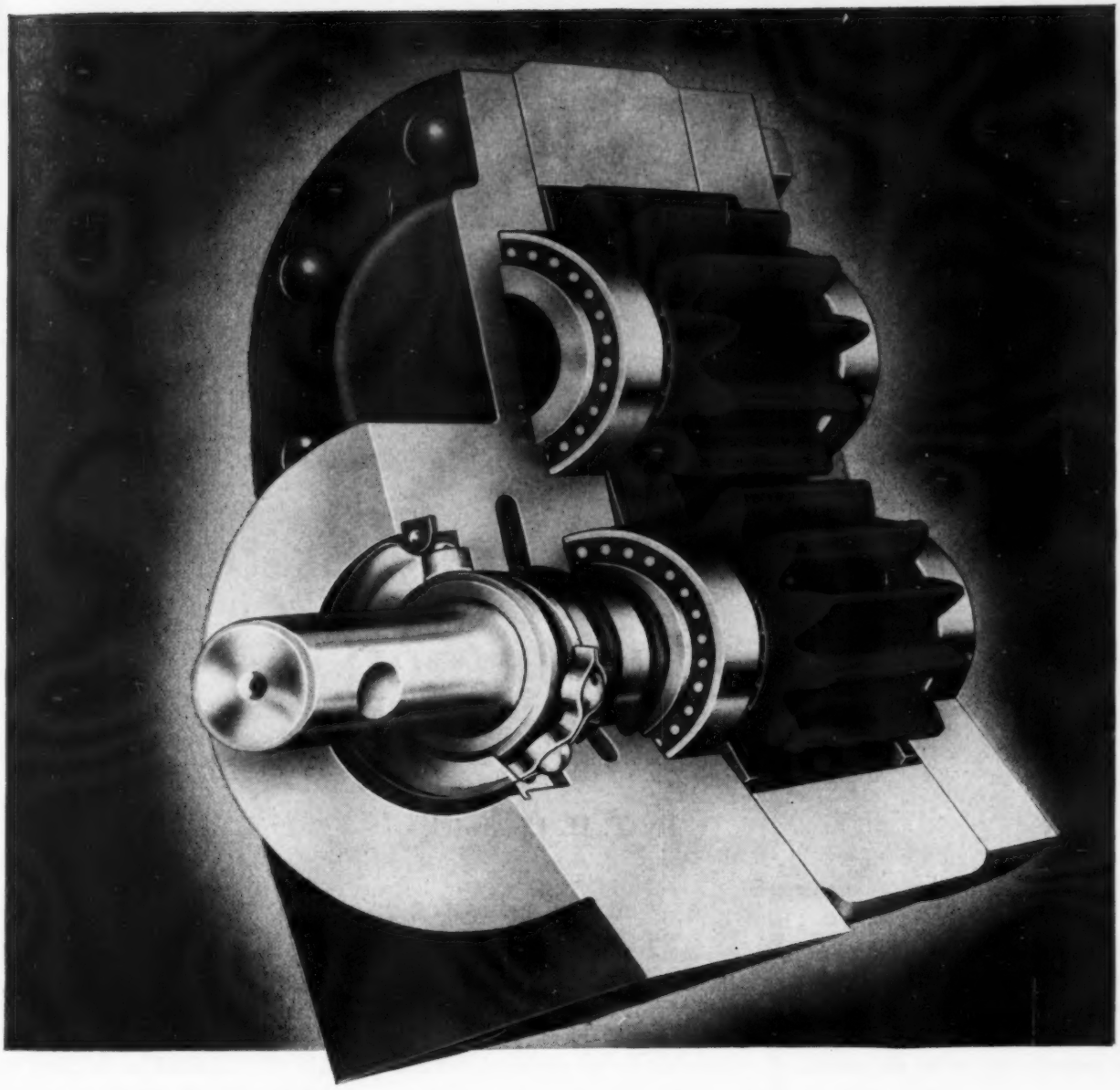
The ram must deliver 50 tons; stroke five inches at a ram speed of three inches per second. Die loading or idle time is two minutes. Ram being used has an area of 50.27 square inches.

From these conditions the total ram volume is computed:

$$\text{Area} \times \text{stroke} = 50.27 \times 5 = 251 \text{ cu in}$$

In the accumulator cross-section drawing this working volume is V_2-V_3.

Continued on page 66



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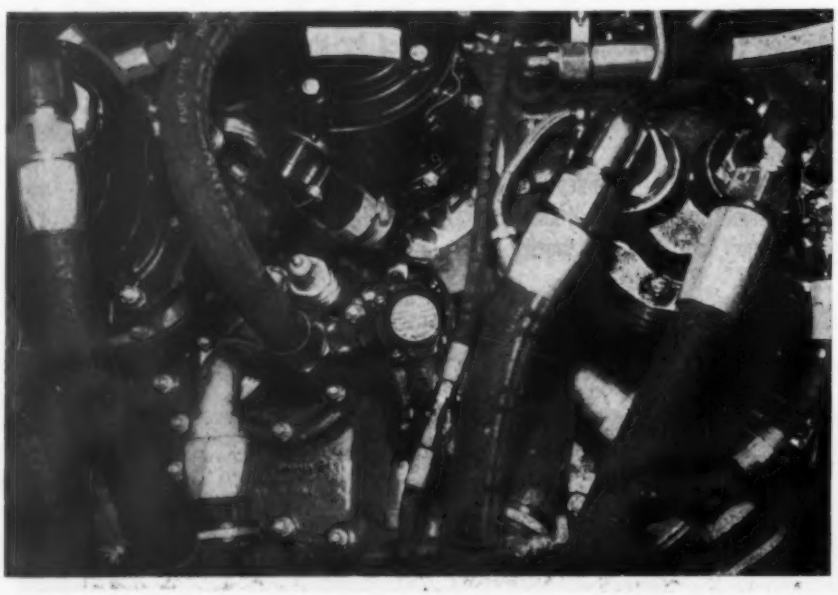
Auxiliary Hydraulic Systems on the T-29B

By T. H. Chadwick

THE T-29B, a modified Convair-Liner used as a USAF crew trainer, has two auxiliary hydraulic systems, one for driving the compressor for the cabin air conditioning system, the other for driving a gearbox for an alternator and generator.

The circuit for the cabin air conditioning system is shown in Figure 2. In the cabin air conditioning system, the compressor, which provides cabin air flow, is driven remotely by two hydraulic pumps (15 and 16), mounted on the right hand engine, and two hydraulic motors (5), mounted on the compressor. The compressor impeller speed varies from 19,000 rpm to 32,000 rpm depending on the cabin air conditioning requirements.

FIG. 1. A VIEW of the right hand engine from inside the wheel well looking forward. The pump on the right is the larger pump of the cabin pressure system. The left hand pump is for the alternator and generator drive system.



A reactor type modulating valve (9) controls the compressor speed by discharging a portion of the hydraulic flow from the pressure circuit to the pump inlet circuit through an oil cooler (10). Control pressure for this valve originates from a flow control valve (1) which is mounted on the compressor. Components of the compressor installation are shown in Figures 3 and 4.

The total head and static pressures are sensed at the air discharge

T. H. CHADWICK, Fluid Mechanics Group Engineer, Consolidated Vultee Aircraft Corporation, San Diego, Calif.

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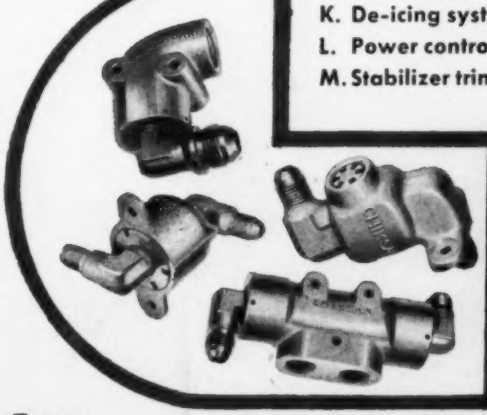
- G. Emergency dump chute
- H. Flap actuating system
- I. Power-plant fuel and oil lines
- J. Wing fold
- K. De-icing system
- L. Power control system
- M. Stabilizer trim



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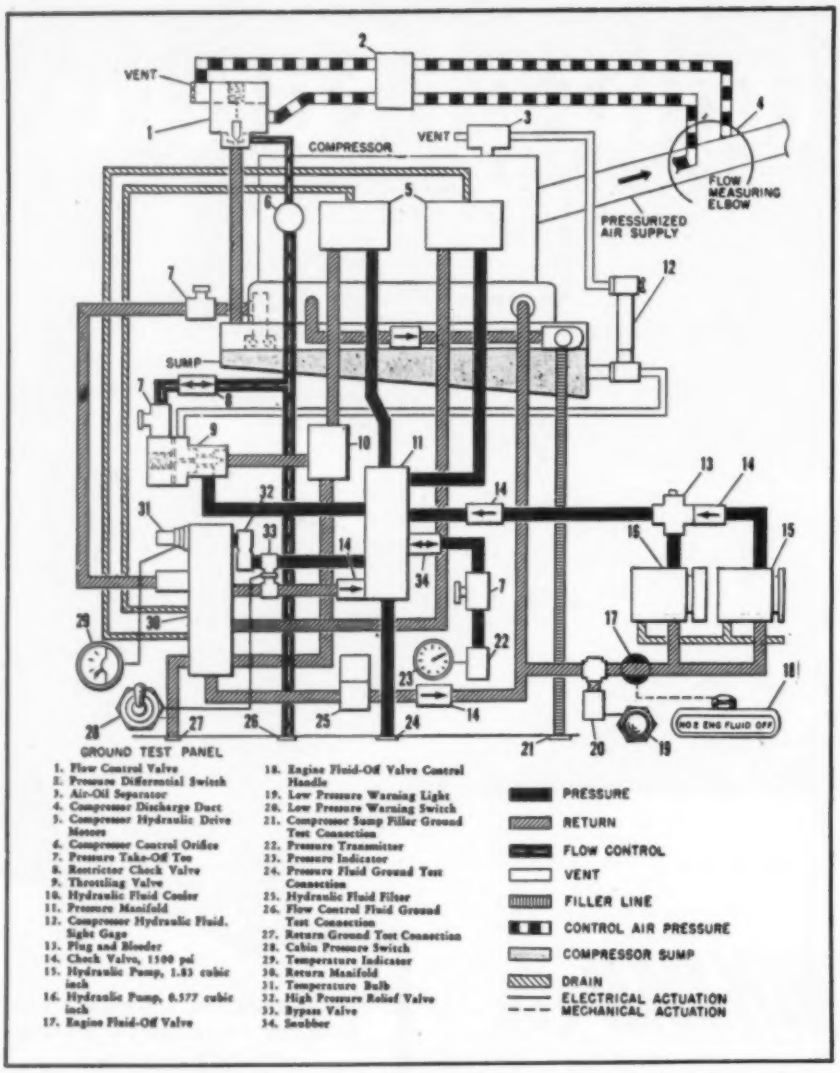


FIG. 2. SCHEMATIC diagram of the cabin pressure hydraulic system.

outlet (4) of the compressor; they act on opposite sides of a spring loaded diaphragm which, in turn, actuates a hydraulic metering orifice in the flow control valve. The metering valve increases or decreases the control pressure for the modulating valve. This control pressure, acting on a spring loaded diaphragm, moves a tapered plunger which acts as a variable orifice to change the amount of oil being bypassed from the pressure circuit to the pump inlet circuit. When the cabin requirements increase, resulting in a change in the pressure differential at the air discharge outlet of the compressor, the flow control valve will sense this change, and will increase the control pressure to the modulating valve, which decreases the amount of oil being bypassed. This allows more oil to flow to the motors and increases the compressor speed.

A sump pump in the compressor supplies fluid to the main pump return circuit (Figure 1), maintaining positive pressure to the main pumps. A relief valve between the manifold and sump maintains 60 psi in the manifold. Lubrication is obtained by means of orifice openings in the manifold.

Two fixed displacement, engine driven pumps supply power for the hydraulic system. One of these

FIG. 3. THIS VIEW of the compressor installation was taken looking up at the trailing edge of the wing between the fuselage and right hand engine nacelle. Units visible are the compressor with hydraulic motor.

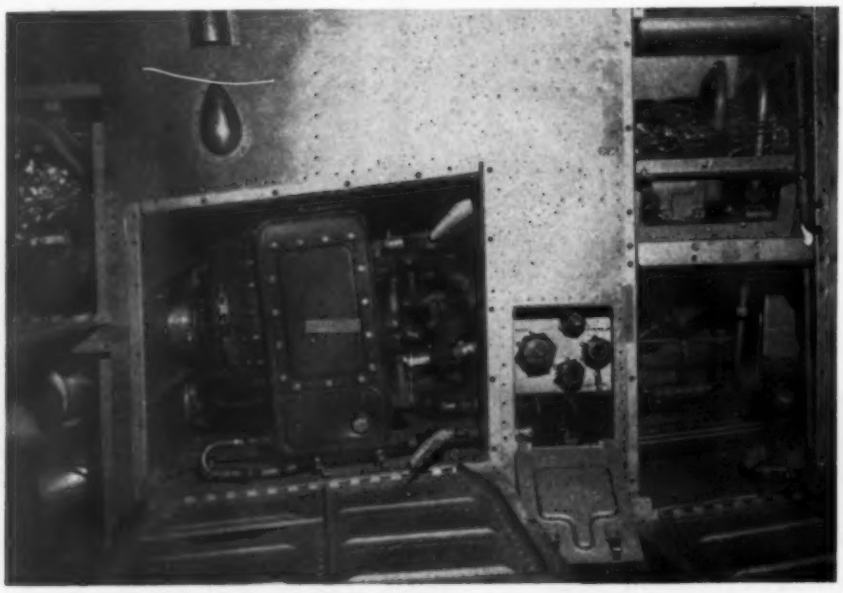


FIG. 4. A VIEW immediately to the right of view in Figure 2 shows the ground connections, the relief valve, both manifolds, the filter and the oil cooler of the cabin pressure system.

pumps is shown in Figure 1. Both pumps have common pressure and drain lines at the firewall. The pressure from the engine driven pumps drives the two hydraulic motors attached to the compressor housing. These motors are of the fixed displacement, piston type and drive the compressor impeller at 8.4 times the motor speed through internal gears in the compressor. As stated previously, the motor speed is regulated by the flow control valve. All by-passed oil, and the oil from one motor, passes through an oil cooler (10) and filter (25) before returning to the pumps.

The system contains a by-pass valve (33) and line which is utilized when it is desired to make the compressor inoperative. In this case, the by-pass valve is opened and fluid passes from the pressure line to the return line, by-passing the compressor.

Alternator-Generator System

The alternator-generator hydraulic drive system was developed because the engines did not have sufficient pads for driving the alternator and generator directly. The hydraulic system (Figure 5) is a closed type, utilizing an engine driven pump (10) and a remotely

Continued on page 59

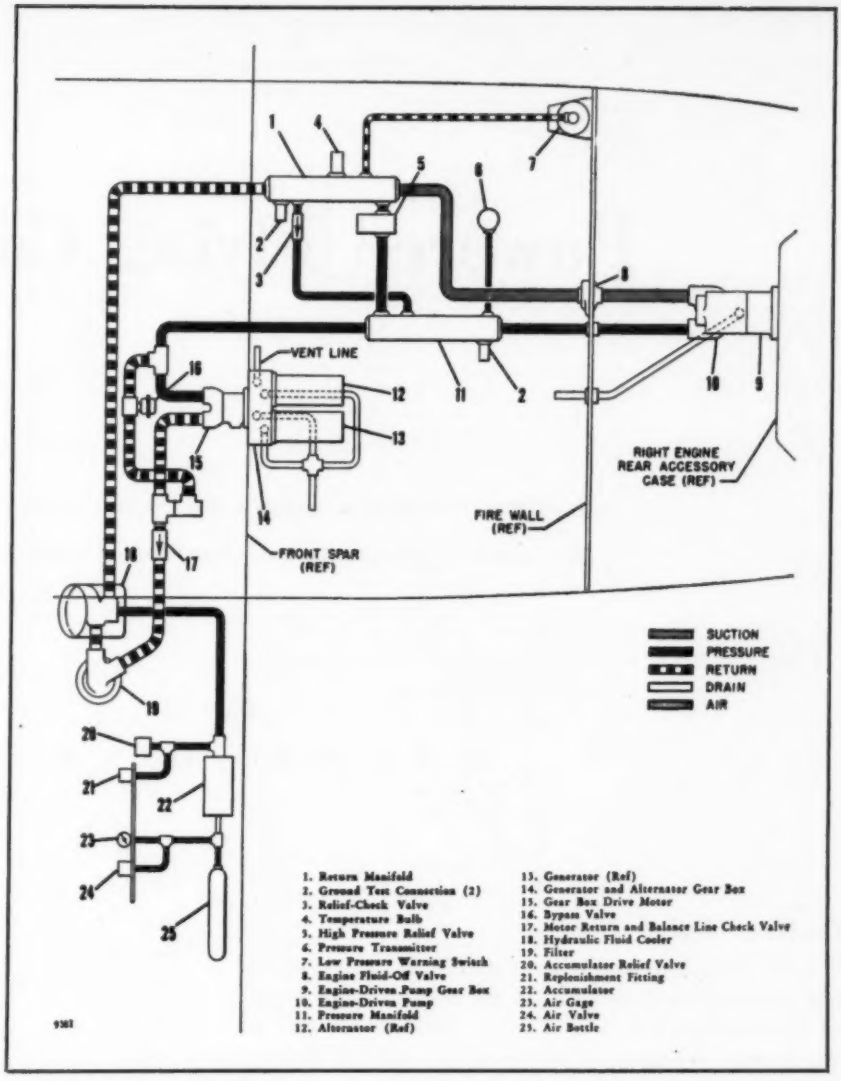


FIG 5. SCHEMATIC of the alternator-generator hydraulic drive system.

FIG. 6. THE alternator-generator drive installation. The view looks up and aft in the right hand wheel well. Components visible are hydraulic motor, alternator and generator gear box and the by-pass valve.

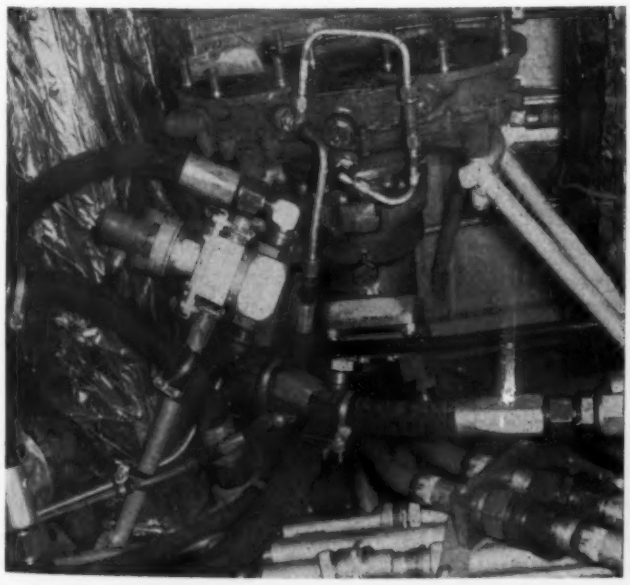
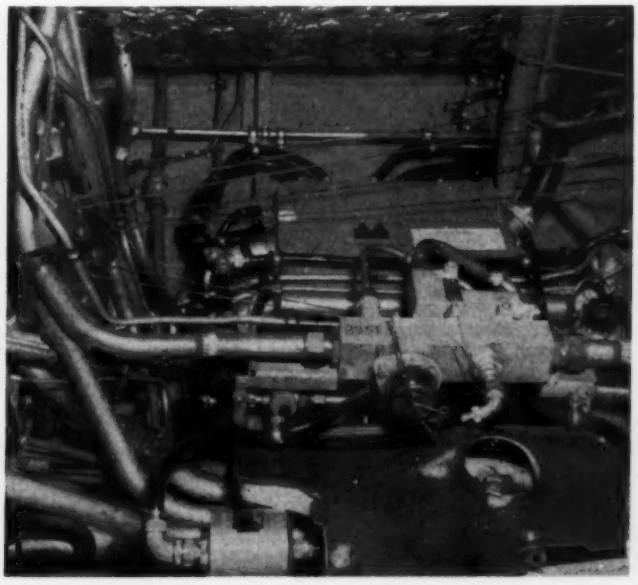


FIG. 7. BOTH MANIFOLDS, the relief valve and the low pressure warning switch of the alternator and generator drive are shown in this view looking up into the right hand wheel well.



Powered Flying Controls

Design of control valves to improve the stability of the simple proportional control system is discussed.

Part 3

By F. J. Bradbury and S. M. Parker

Control Valve Design

In an aircraft servo system the detail design of the control valve determines: (1) the sensitivity or extent of detectable error, and (2) the response or rate of movement. When using valves of the familiar plunger type, the sensitivity is controlled by the extent that the valve can move without application of power, and this is frequently termed "overlap". In determination of the extent of this overlap two conflicting requirements arise. First, to achieve good stability or freedom from power movement under the influence of small amplitude oscillations, the overlap should be large. Secondly, to provide a smooth control without any feeling of lumpiness, the overlap should be small.

In some early systems the authors used an alternative control valve (Fig. 8), which can be termed the "opposed poppet" type. This valve has virtually no overlap and, as a consequence, its sensitivity was too high to accept the degree of circuit flexibility normally encountered, and incurable instability resulted. On the basis of this experience, plunger valves of the type shown in Fig. 9 have largely superseded the opposed poppet valve.

Further experience on plunger valves suggested that an overlap of at least 0.010 inch is required. On the other hand, with velocity ratios of 10/1 between the pilot's control movement and the valve movement, not more than about 0.020 inch can be used if reasonable continuity of control force is to be obtained. While this leaves a possible working tolerance of 0.010 inch, for stability it is very desirable to use as great an overlap as possible, and maintain a figure of 0.015-.020 inch.

From Fig. 9 it will be seen that the overlap is controlled by only two dimensions, namely, the width of the annulus in the valve housing and the length of the land on the valve itself.

The maximum response rate of the system will depend on a number of factors, of which the maximum valve opening is but one, since other restrictions in a system of minimum bulk and weight must be taken into account. The general response characteristic at lower rates, however, will be almost entirely determined by the valve design. Typical valve-opening curves are shown in Fig. 10. The neutral or zero error position of the control valve corresponds to the OY axis, which also coincides with the point of valve-opening for the opposed puppet valve illustrated in Fig. 8. The dotted line indicates how full response is obtained at very small valve displacements in the case of opposed poppet valve. This curve is characteristic of a highly sensitive and responsive control, and approaches that of an "on-off" system. Points A and A^1 correspond to the point of valve opening for the piston type of valve, having positive valve overlap AOA^1. From the points of valve opening to valve displacements B and B^1 where the valve plunger reaches the limit of its travel, the valve opening can be varied as required. The port areas indicated by points C and C^1 are governed by the maximum rate of control movement specified by the aircraft designer. Similarly, valve travels OB and OB^1 are controlled by the al-

F. J. BRADBURY and S. M. PARKER, Automotive Products Ltd., Leamington Spa, England.

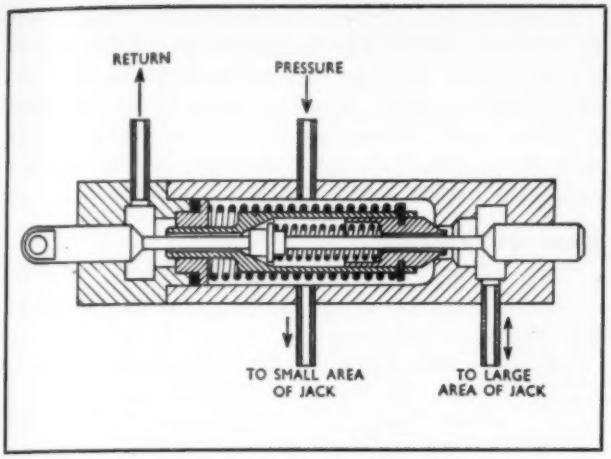


FIG. 8. Opposed poppet valve has virtually no overlap. While the valve has a high sensitivity, instability results.

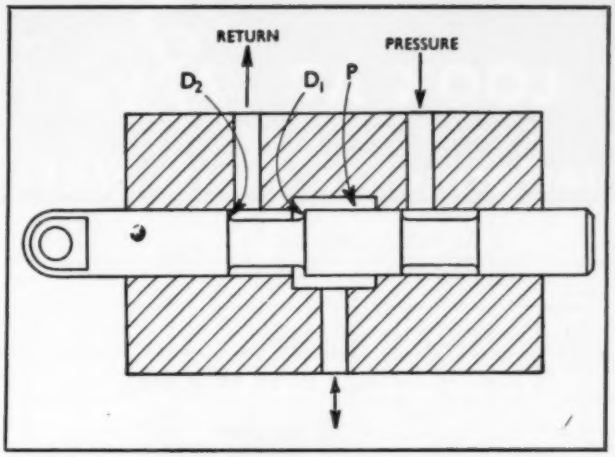


FIG. 9. Overlap can be adjusted on the plunger type valve to compromise between desired stability and sensitivity.

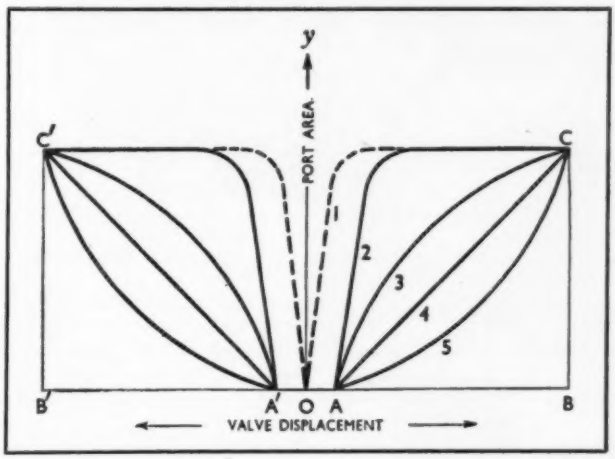
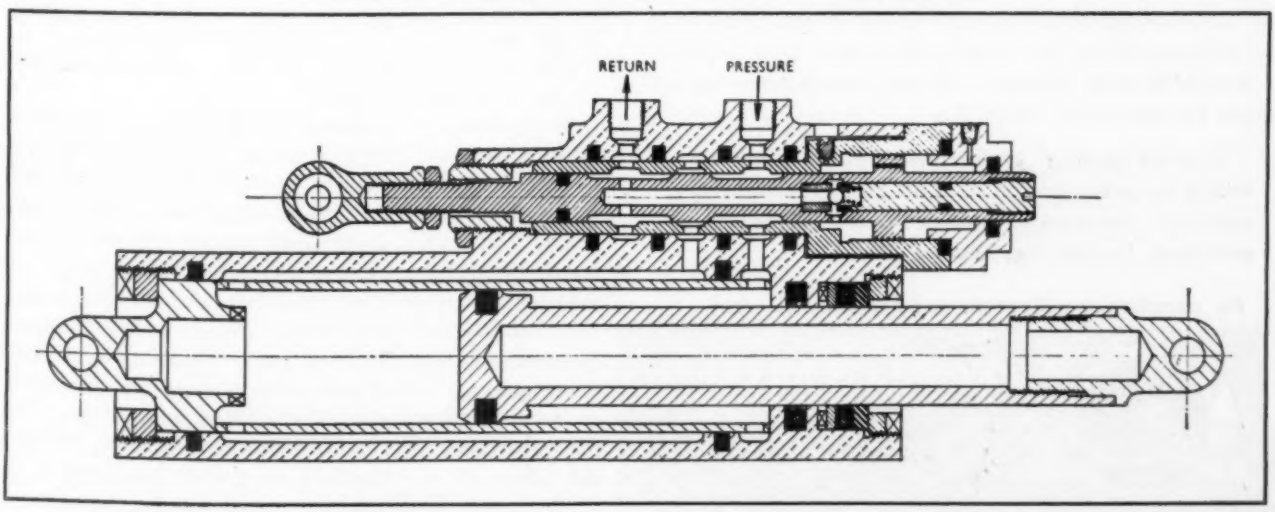


FIG. 10. Typical valve operating curves show amount of valve opening with valve displacement. Curve 1 is for an opposed poppet valve. The other curves are for plunger valves with varying land profiles. Valve 2 has square shoulders; 3, concave taper; 4, straight taper; 5, convex taper.

lowable maximum transient error and the maximum backlash that can be accepted on reversion to manual control. The maximum valve travel is limited by the allowable transient error, and the valve overlap denoted by AOA^1, is governed, as previously outlined, by stability and feel requirements. As a result of these limitations, the designer of the servo-mechanism is left with the valve travel AB and A^1B^1 in which to obtain the best possible response characteristic. This may be obtained by variations in the profile of the

FIG. 11. This servo controlling unit incorporates a hydraulic damper. The damper is integral with the valve plunger.



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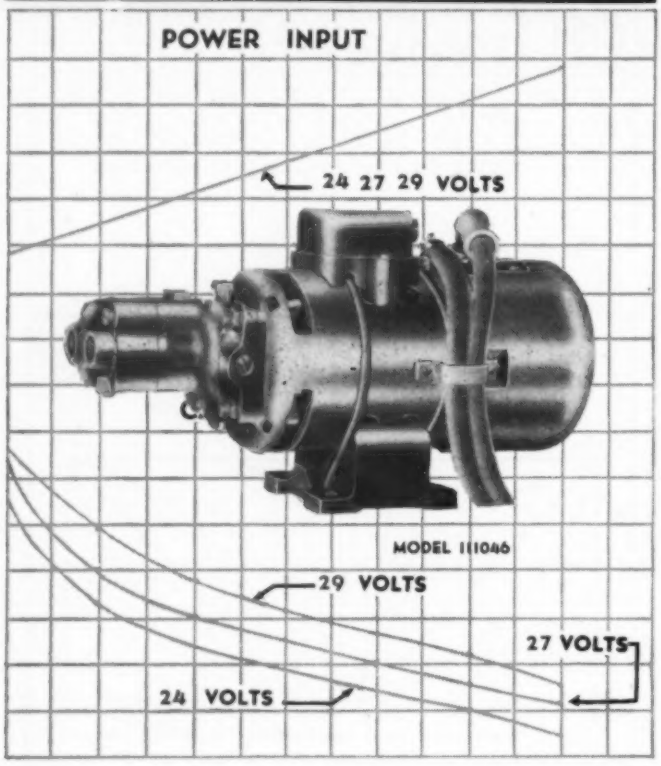

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controlling portions of the valve plunger.

It may be seen that much can be done to improve the stability of a servo-mechanism by careful attention to circuit flexibility and control-valve characteristics. Unfortunately, however, cases frequently arise in which these factors are limited by practical considerations, and it becomes necessary to incorporate an additional stabilizing unit.

Damper Design

To be effective a damper must absorb energy and be connected between two relatively moving points in the oscillating system.

There are three possible alternative positions:

(1) between input circuit and aeroplane structure;
(2) between output circuit and aeroplane structure; and
(3) between input cirucit and output circuit.

Where manual operation of a control surface is possible in the event of power failure, the first two positions are not satisfactory, since the pilot would have to do considerable work against the damper. The third position is therefore generally used. This is equivalent to damping between the valve and valve body, which comes into operation whenever there is a change of error, and with a hydraulic damper the damping force is a function of the rate of change of error.

Alternatively, a dry friction damper can be used, but experience suggests that this form of damper is not altogether suitable in most cases due to:

(1) inconsistency under service conditions;
(2) tendency to worsen feel-characteristics;
(3) tendency to control creep;
(4) difficulty in achieving satisfactory self centering; and
(5) damping which is either independent of frequency or decreases with increase of frequency.

Hydraulic dampers are widely used for a variety of purposes, but they mostly operate at relatively large amplitudes. When they are attached between valve plunger and valve body a small movement only is available to provide a stabilizing action. It is therefore vital to eliminate backlash and reduce the effect of air included in the fluid. In general, a hydraulic damper should possess the following features:

(1) the unit should be fully hydraulic (preferably pressurized);
(2) automatically charged with fluid;
(3) not greatly affected by changes in temperature;
(4) should not influence self-centering characteristics; and
(5) should not appreciably increase valve-operating loads at normal frequencies.

An example of a hydraulic damper used successfully in powered flying controls is shown in Fig. 11. In this design the damper piston is formed integrally with the valve plunger to ensure positive control, which is essential where small overlaps are employed. The number of rubber seals acting on the valve plunger of the unit is not greater than that normally employed and, consequently the operating load at low frequencies is unaffected. Other hydraulic dampers have been developed for installation where they are subjected to an amplification of the relative motion between the valve and valve body. This arrangement reduces the effect of any backlash in the damper unit and, furthermore, amplifies the actual damper force.

Abstracts from the Hydraulics Conference

Held in Chicago, September, 1952

"Noise in Hydraulic Pumps"

E. L. Midgette, head, department of mechanical engineering, Polytechnic Institute of Brooklyn.

This paper attempts to explain the origin of hydraulic noise in pumps and to set up a method of effectively minimizing noise at its sources. Both origin and control of noise in the design of the gear and the axial piston type pumps are treated. Data presented demonstrated that the noise in both types of pumps originates from the same phenomena—sudden pressure increases in rapid sequence on discrete quantities of the fluid pumped. Data was presented in chart form showing how noise level of each type of pump varies with pressure when successive degrees of noise correction are made.

"Low Temperature Application of Industrial Hydraulic Oils"

D. K. Nason, technical and research division, Beacon Laboratories, The Texas Company.

This paper demonstrated the fact that physical properties become increasingly important in comparison to chemical properties as far as pump efficiency and general operating conditions are concerned, as hydraulic system temperatures decrease. Data contributed by several pump manufacturers and The Texas Company on laboratory tests with rotary vane, gear and reciprocating piston pumps of industrial type was presented. These data were analyzed and discussed with the emphasis on the effect of the physical properties (viscosity, viscosity index and pour point) of the fluids tested upon the efficiencies, cavitation tendencies and noise levels of pumps of these types.

"The Surface Type Seal—For Tougher Jobs"

R. O. Isenbarger, chief engineer, Chicago Rawhide Manufacturing Co.

Pointing out that the surface type or axial seals are steadily growing in use in hydraulic machinery for prevention of the escape of hydraulic and lubricating mediums, the speaker outlined the functional elements essential in every axial seal. Most important are the flat surfaces which must be maintained sufficiently flat under all operating conditions to prevent passage of the sealed mediums between them. Smoothness and material selected must result in minimum torque and wear. Other elements maintain the surfaces in contact, assure their positon, allow proper movement and prevent leakage.

Continued on page 64

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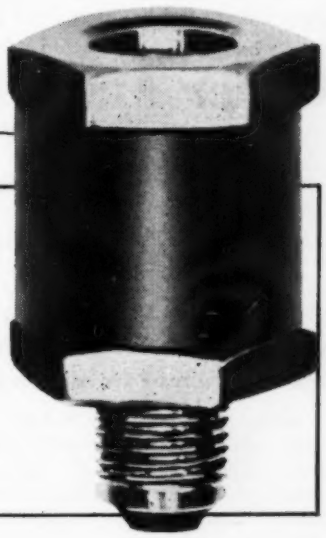

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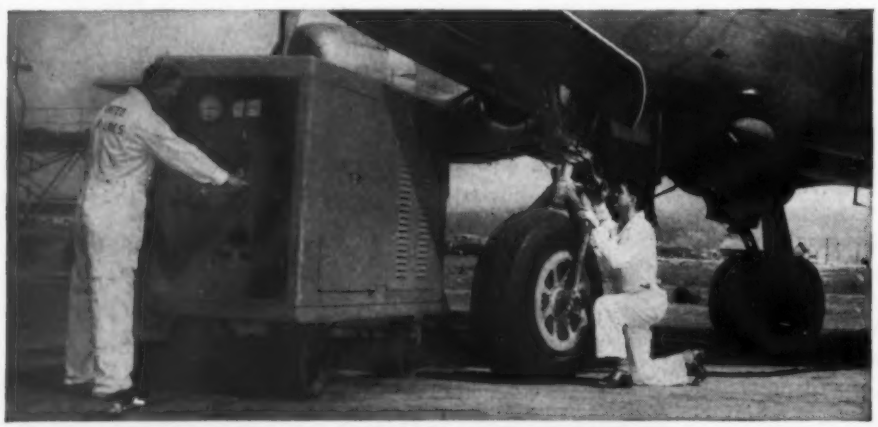

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Announce Agenda for 1952 Transport Hydraulic Conference

A tentative agenda for the second Transport Aircraft Hydraulic Conference, which will be held at Hotel Sheraton, Detroit, on October 28 and 29, has been announced by Walter L. Flinn, of Vickers, Inc., Arrangements Chairman. Subjects will be discussed in the following order: hydraulic pumps (fixed, variable displacement and electric, motor driven), hydraulic motors, hydraulic valves, hydraulic accumulators, hydraulic fluids, hydraulic tubing, hydraulic hose and hydralic fittings.

Wililam E. Spearman, assistant manager of service engineering for American Airlines, Inc., will preside as chairman for the two day meeting.

Because of the procedure of incorporating guest suggestions and questions into the Conference agenda, the final agenda will be ready only when the chairman calls the first meeting to order. This plan of participation, used in the first Conference last year, assures that the most important and the controversial subjects will be given full attention and be adequately discussed.

Accessory Problems

In some cases, efforts are being made to combine similar and allied questions so that a single authority can offer a consolidated reply. The subject will then be opened for discussion from the floor. For example, Robert W. Phillips of the Weatherhead Co. is preparing a brief on Ermeto fitting service considerations; a safetly fluid manufacturer will brief their new development program. Appropriate representatives of the host organization, Vickers, Inc., will discuss current accessories, problems they present and describe designs pending use on newer transports.

Suggestions by mail are invited for companies that will not be represented by personnel. The registration of 80 from airframe, airline, fittings, accessory and oil companies and the Services of last year's Conference is expected to be exceeded at the 1952 Conference.

Hydraulic System On The T-29 B

Continued from page 53

driven hydraulic motor (15). This motor drives a type B-1 alternator and an AN 3634 generator through a gearbox (14). Figure 6 shows the alternator-generator drive installation.

The output speed required by the alternator and generator at engine cruising rpm determined the gear ratios for the gearboxes driving the hydraulic pumps and motors, with allowances being made for their respective efficiencies. The hydraulic pressure will vary according to the electrical requirements. The maximum normal hydraulic pressure is 2640 psi. The hydraulic relief valve is set at a maximum cracking pressure of 3450 psi to provide excess power for momentary electrical surges.

One fixed displacement, engine driven pump (10) supplies power for the hydraulic system.

Accumulator Fills Closed System

Since the hydraulic system is a closed type, not having a reservoir through which fluid circulates, an accumulator (22) is teed into the pump suction line to keep the system full of oil at all times. A low pressure air reservoir (25) is connected to the air end of the accumulator to effectively increase the air volume so that the pressure difference between full and empty accumulation will be a minimum. The charging pressure with the accumulator full of oil is 85 psi. The accumulator is bled of sufficient oil to allow for thermal expansion; the accumulator should be serviced when pressure falls below 60 psi. A relief valve (20) is installed in the suction line to prevent pressure in excess of 100 psi. Figure 7 shows this valve and other components in this circuit. This system includes an oil cooler (18), which regulates the oil temperature at approximately 125 F during normal operation of combined output of the alternator and generator.

A by-pass valve (16) is installed in the system; this valve may be used to by-pass fluid around the hydraulic motor in an emergency.

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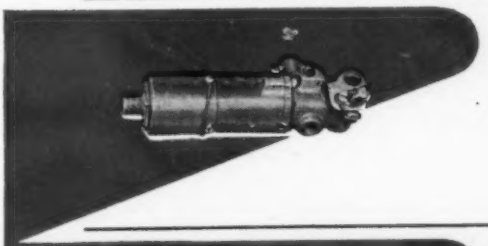

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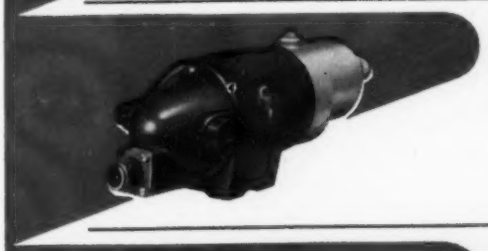

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How To Assemble Threaded Tube Fittings

Part 4 of a series on Fluid Lines

By R. W. Phillips

FITTINGS can be classified into two general groups: (1) Flared fittings and (2) Flareless fittings. In the next several articles a number of representative fittings now in general industrial use will be described. We will explain how the fitting works, list the advantages and the limitations of each type of fitting.

Before discussing the tube fittings, it would be advisable to describe the pipe threaded connections used on many tube fittings. Two types of pipe threads are in common use—National Taper Pipe Threads and Dryseal Taper Pipe Threads. These threads are completely interchangeable; they will mate with each other without interference. Dryseal pipe threads will give joints having less leakage than National Taper Pipe threads. However, either can be made to seal with the other. A sealing compound must be used when one of the threads is not Dryseal.

The Dryseal American Standard Taper Pipe Thread differs from the American Standard (NPT) by differences in the truncation of the root and crests of the threads. There is an interference condition of the root and crest of the thread before the flanks of the thread engage. Figures 1 and 2 show the American Standard and the Dryseal designs.* The interference in the Dryseal thread insures that no spiral leakage, such as occurs normally in the American Standard thread, can result. This interference also eliminates the need to use thread lubricant or pipe thread sealer to seal against spiral leakage. It is advisable that light oil be used as a lubricant to prevent galling of pipe threads; however, a sealer is not necessary.

It is advisable to lubricate all pipe threads before assembly. When any pipe threads excepting Dryseal pipe threads are mated, a sealer should be used instead of the lubricant. Any light oil will serve as a lubricant. White lead, Bakelite varnish, Petrolatum or any of a number of sealers can be used with a thread combination requiring sealing.

* *Complete specifications are in ASA B* 2.1, 1945

FIG. 1. THE AMERICAN National Taper Pipe Thread (NPT). The external thread is always taper; internal thread is taper for high pressure service, straight for low pressure service. A lute or floating packing is usually incorporated into the assembly.

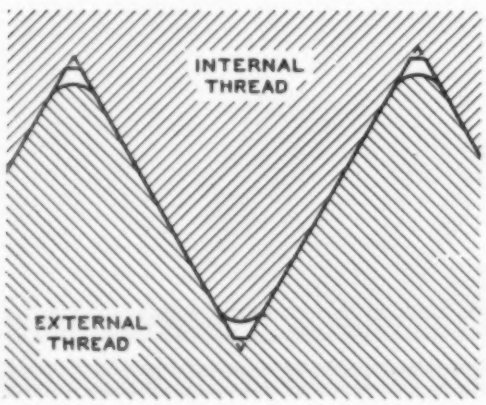
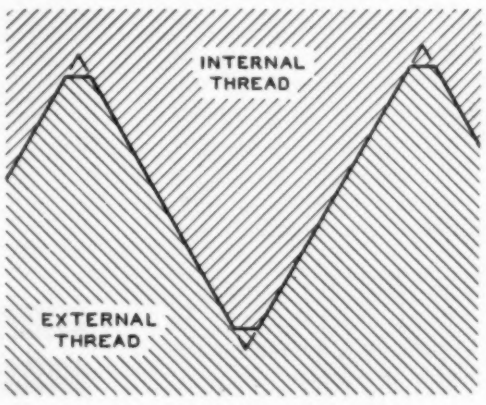


FIG. 2. THE DRYSEAL American Standard Taper Pipe Thread differs principally from the NPT Thread in that the length of engagement of the external taper thread at the small end is shortened. Dryseal thread roots and crests contact before flanks of thread engage, preventing spiral clearance.



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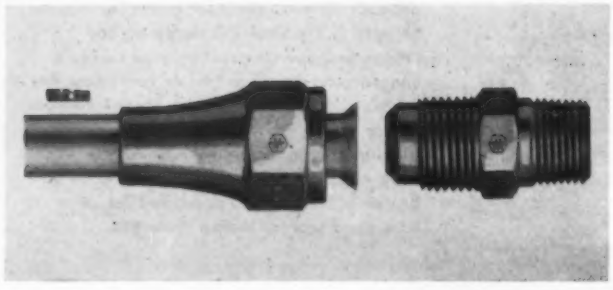


The Dryseal pipe thread is given an interference fit which will seal metal to metal when the threads are properly made. The male thread can be easily checked and is rarely out of tolerance. The female thread is difficult to check and, therefore, is usually the thread which is out of tolerance when leakage occurs. The easiest exact method of checking the female thread is to make a sulfur cast of the thread and check the cast. For other reasonably exact checks, the following gauges must be used: (1) gauge for checking the pipe diameter; (2) gauge for checking effective length of the thread; or (3) a profile plug gauge.

Tightening Procedure

When tightening pipe threads, it is advisable to use the following procedure. Lubricate with oil or coat the male thread with sealer, run the threads together hand tight. Turn the fitting one and one-half turns with a wrench. This should give a tight joint which will seal up to 1000 psi. If seepage does occur, apply not more than one additional turn. If this does not seal, check the female thread for out of tolerance and the male thread for chatter marks. Do not overtighten. It is better to check first before disturbing the threads or tightening to a point at which they are not serviceable.

If properly made and installed brass **pipe threads will hold about 1000 psi without seepage. Where the pressure exceeds 1000 psi, seepage will occur. This seepage cannot be completely cured by retightening, since seepage will occur periodically as a result of the creep of the brass.

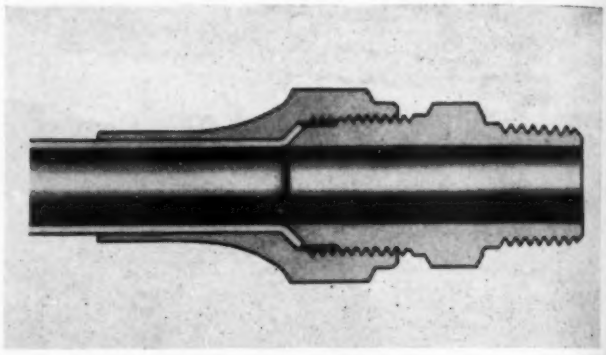
Steel pipe threads can be made to hold 3000 psi or more but, in general, seepage will occur at that pressure range or less. Straight threaded steel fittings, flared or flareless, will give superior results much more consistently and should, therefore, be used when pressure are in the 3000 psi range.

When leaks are encountered in any tubing installation, don't just wind up everything as far as it can be made to go. Instead, examine the installation and its components. Try to find out what is wrong. If such leakage occurs on many units using the same type of fittings, call in the manufacturer and correct the errors in assembly. Do not repeat errors in future assemblies.

** *Section H4.1.6.3 of J.I.C. Hydraulic Standards for Industrial Equipment states that copper tubing and copper alloy fittings are not permissible with petroleum base fluids.*

FIG. 3. THE SAE flared connector and nut with long tube supporting section.

FIG. 4. A CROSS section of the SAE flared connector and nut tube fitting.



The result should be a dry hydraulic system with minor leakage and very little maintenance work required. Overtightening fittings usually destroys them or at least reduces their life. Learn how to use fittings properly and successful piping of equipment will result.

We will discuss the type of flared fittings first, then cover the flareless fittings. Each fitting will be described and its differences from other types will be pointed out.

SAE Flared Fittings

One of the oldest of the flared fittings is the SAE flared fitting. It is used in automotive, marine and refrigeration piping principally. This fitting consists of two parts, a connector and a nut. The connector has a 45 degree seating surface, a relieved portion not threaded and a threaded portion. Most of these fittings in common use are brass, but steel fittings have also been made. The nut has a long or short tube supporting section. Figure 3 shows a long nut and connector. The refrigeration industry uses a special frost free nut.

The fitting seals by forcing the metal of the flare of the tubing against the 45 degree seat of the connector. The shoulder of the nut supplies the confining force. The tail of the nut acts as a support for the tubing and removes the stress from the flare so that failure, due to vibration, is reduced. Figure 4 shows a cross section of the SAE long nut and connector.

The safest method of assembly would be to use a torque wrench, but since that instrument is often not available and is difficult to keep in calibration, a technique should be developed on the basis of experience. Some methods of assembly advocate that you should apply as much torque as possible, using the fingers, then applying a given number of turns by wrench. This does not work satisfactorily because of the variation in threads, accessibility of the fitting and variations in finger strength.

The following procedure is suggested. Apply a

Continued on page 91

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Continued from page 57

"Tractive Equipment and Material Handling"

J. Foster Oury, president, Imperial Construction Equipment Co., division of Imperial Ready-Mix Concrete Company.

Mr. Oury reviewed the research and engineering work conducted in applying hydraulic principles in two new fields of service: (1) hydraulic transmission for concrete, transit mixers; and (2) hydraulic power transmission to the wheels of a semi-trailer trucking unit so that adequate tractive effort is available for off-the-road operation. For the mixer installation, the speaker pointed out that the hydraulic circuit eliminated the conventional separate gas engine drive, a savings in excess weight, space and maintenance resulting in a better weight distribution and increase in pay-load. In the semi-trailer trucking unit, Mr. Oury described a practical solution to the tractive effort problems of an off-the-road semi-trailer. With hydraulic power applied to the trailer wheels, the effective tractive effort was raised from 30 to 80 percent of the total load weight, making it possible to negotiate extremely bad off-the-road conditions successfully. Design, component and performance test results were shown.

"Commercial Vehicle and Passenger Car Power Braking"

W. R. Williams, executive engineer, Bendix Products Division, Bendix Aviation Corporation.

Mr. Williams pointed out briefly the history of power brake systems on heavy vehicles, especially trucks, truck-tractors and busses and importance of the introduction of hydraulic brakes, introduced in the early '30's. He described the integrated hydraulic brake system for automotive use, as well as vacuum and air pressure units, also integrated units. He described the newest advances in the reduction of brake pedal loads and reviewed design features and operating characteristics of the modern power brake systems now available for passenger cars.

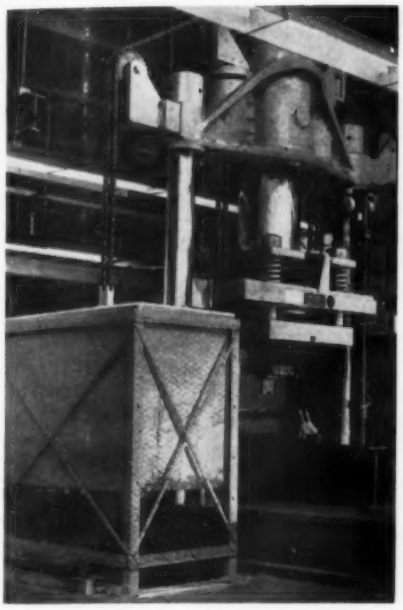
"Air Operation of Hydraulic Gauges and Controllers in Water Filter Plants"

A. A. Kalinski, director of development, Infilco, Incorporated.

The control valve which automatically opens and closes to control flow to maintain a constant rate of filtration as the head loss through the filter bed changes is described. The valve, with iris-type vanes in the recovery portion of a venturi tube, is controlled through air pressure controls, with the venturi differential providing the actuating force. This differential is transmitted pneumatically to a rate of flow gauge, through a so-called converter which converts the differential to a linear controlled air pressure. This controlled air pressure actuates an air motor which positions the vanes of the valve. The rate of flow through the filter and the loss of head are indicated and recorded on gauges which are actuated by converters that convert the loss of head pressure to a controlled air pressure which is directly proportional to either the loss of head or the rate of flow.

Concrete Blocks Counterweight Hydraulic Testing Machine

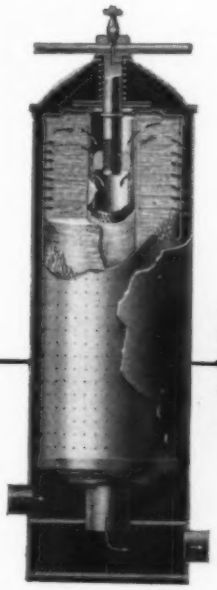
A testing machine of unusual specifications has been built and installed for proof testing of hydraulic type aircraft landing gear



at Menasco Manufacturing Company, Burbank, Calif. Specifications for this machine were developed by cooperation of Baldwin-Lima-Hamilton Corporation's testing equipment department and Menasco production engineers.

The 600,000 pound compression testing machine consists of a hydraulic loading cylinder mounted as a fixed crosshead on two 9 inch diameter steel columns set in a bed plate of floor level. Loads are applied by a 21 inch diameter ram with 4 foot stroke and two speeds. Load can be applied at 0-6 inches per minute and the approach speed is 0-30 inches per minute. Clear space in the machine is 6 feet vertically and 6 feet between columns.

In order to duplicate the action of single ram machines for load holding and instantaneous return, two concrete block counterweights weighing 10,000 pounds each (approximately 72 cu ft) are used in place of the customary pull-back hydraulic cylinders. Large, double roller chains running over sheaves on top of the crosshead support the concrete blocks on the sides of the columns.



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KOBE Heavy Duty High Pressure

Triplex Pumps

Case History A-11: July 1947, a Kobe Size 3 Triplex was installed in the engineering test laboratory of the El Segundo Division, Douglas Aircraft Company, Inc. The pump is used primarily for impulse testing, wherein the articles tested are subjected to a 4500 p.s.i. pressure peak at a rate of 90 cycles per minute.

". . . Most Severe Destruction Test"

Rate of pressure rise is approximately 200,000 pounds per square inch, per second. P. G. Smith, Manager of the Douglas Engineering Laboratories, states "This is probably the most severe destruction test used to qualify hydraulic components. The Kobe Triplex in its years of service has been subjected to millions of these impulse surges. There has been very little maintenance cost during the the period of operation".

Triplex Features

- Pressures—To 5,000 psi (standard) To 20,000 psi (special)
- Volumes—To 60 g.p.m.
- Power Ratings—15, 30, and 50 H.P.
- Integral Double Reduction Gears
- Integral Electric Drive (Optional)
- Easily interchanged Plungers and Liners

Write for Bulletin

KOBE INC., Division of Dresser Equipment Co., 615 NBC Bldg., 815 Superior Ave., N.E. Cleveland 14, Ohio

KOBE INC.

Division of Dresser Equipment Co.
Plant: Huntington Park, Calif. — Representatives in CLEVELAND, Pittsburgh, New York, Houston, Oklahoma City.

Circle 37 on Reader Service Card
Circle 44 on Reader Service Card

Circle 21 on Reader Service Card

Whatever the Weather-
aloft or aground—Be sure of reliable precision control with

ELECTRO SNAP

HERMETICALLY-SEALED LIMIT SWITCHES

Reliable in any environment, Electric-Snap *Hermetically-Sealed* Limit Switches with working parts sealed in an atmosphere of dry, inert gas are unaffected by heat, cold, moisture, dirt and temperature cycling. Available with both mountings and actuators to fit them to *retro-fit programs* as well as *new aircraft designs.* Also preferred for industrial precision-switch applications where utmost dependability is essential.

Environment Free!
PROOF AGAINST
• *Cold and Heat—from −100° to +250°* • *Altitude*
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ELECTRO-SNAP SWITCH & MFG. CO.
4218-30 WEST LAKE ST., CHICAGO 24, ILLINOIS

MACHINE DESIGNERS!

GET THE FULL STORY ON HANNIFIN'S

NEW Pilot-Master Air Control Valves!

HERE'S WHY MAINTENANCE MEN PREFER THEM...

FEWER VALVES TO STOCK
Use same valve 2-way or 3-way, normally open or normally closed.

FEWER PARTS TO STOCK
Unique cartridge construction makes "insides" easily replaceable.

INDUSTRIAL SOLENOIDS
Long-lasting, easy to change coils to any standard voltage.

All Sizes From ¼" to 1¼" I.P.S.
Pressures From 15 to 150 P.S.I.
Write for Bulletin 231 and get the complete story!

HANNIFIN
Hannifin Corporation • 1155 S. Kilbourn Ave. • Chicago 24, Ill.

Data Sheet

Continued from page 48

The minimum or final pressure developed by the accumulator is equal to $F/A = \dfrac{50T \times 2000 \text{ lbs}}{50.27 \text{ sq in}} = 2000 \text{ psi}$

Assume an initial or maximum oil pressure P_3 of 3000 psi; final or minimum oil pressure P_2 of 2000 psi and a gas precharge P_1 of 1500 psi. Gas precharge is generally chosen as 50 percent of the maximum working pressure of the fluid.

We now have the following data:

Pressures	*Volumes (gas volumes)*
$P_1 = 1500$ psi	$V_1 =$? (Size of accumulator)
$P_2 = 2000$ psi	$V_2 = V_3 + 250$
$P_3 = 3000$ psi	$V_3 = V_2 - 250$

$$P_2V_2 = P_3V_3$$
$$2000(V_3+250) = 3000V_3$$
$$V_3 = 500 \text{ cu in}$$
$$V_2 = 500+250$$
$$V_2 = 750 \text{ cu in}$$
$$P_1V_1 = P_2V_2$$
$$1500\,V_1 = 2000(750)$$
$$V_1 = 1000 \text{ cu in}$$
$$\frac{1000}{231} = 4.3 \text{ gallons, use a 5 gallon accumulator}$$

Power requirements: For this same press problem the designer must determine the pump and electric motor size. The oil pump has the two minutes of press idle time per cycle in which to recharge the accumulator. The pump must deliver:

$$\frac{250 \text{ cu in}}{231 \text{ cu in/gal} \times 2 \text{ min}} = .54 \text{ gpm}$$

A 1 gpm pump will do the job.

The horsepower required to operate the system is:

$$.000583 \times P \times V$$
$$= .000583 \times 3000 \times .54$$
$$= 1.1 \text{ hp}$$

A 1.5 hp electric motor is selected.

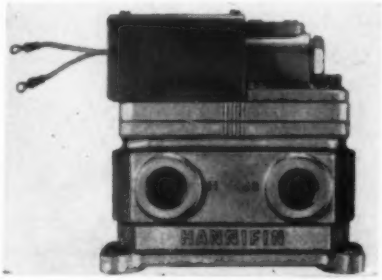
If your problem requires that you find the available working volume of a known accumulator size, you can use the following method:

Where: $V_1 =$ total accumulator volume
$P_1 =$ assumed precharge
$W =$ working volume of fluid

$$P_1V_1 = P_2V_2 = P_3V_3$$
$$V_3 = V_2 - W$$
$$W = \frac{V_2(P_3-P_2)}{P_3}$$

What's NEW in Components for fluid power systems

For more information about these products use the postcard bound in this issue

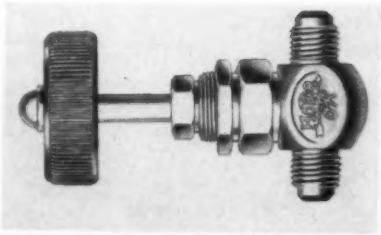


Four-way Air Valve

Hannifin Corporation
Chicago, Illinois

Designation: Series BB 4-way Pilot-Master valve
Operation: Two series B 3-way Pilot-Master valves in one compact common body, with internal coring so arranged that one valve operates normally closed while the other operates normally open. The two valves shift simultaneously when pressure is introduced to the chamber over the two piston poppets.
Sizes: 3/8, 1/2 and 3/4 inch
Features: The two piston poppet assemblies are identical for all three sizes. They both fit in removable, replaceable cartridges.

Circle 151 on Reader Service Card

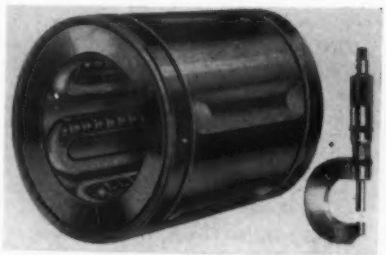


Instrument Panel Valves

Hoke, Incorporated
Englewood, New Jersey

Mounting: The valves are designed for direct panel mounting and are attached to the panel through a single mounting hole.
Styles: They are furnished in a wide variety of thread sizes and styles in brass, stainless steel and aluminum. Also made in angle pattern.
Features: All parts of the valve appearing from the front of the panel, including the locknut, are finished in dull nickel.

Circle 152 on Reader Service Card

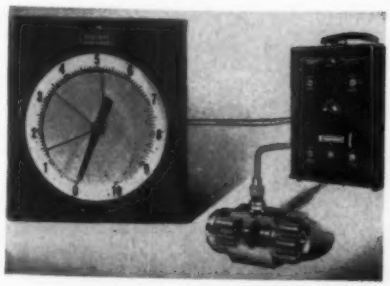


Linear Ball Bearings

Thomson Industries, Inc.
Manhasset, New York

Designation: Ball Bushings
Sizes: For use on shafts up to 2 1/2 inches in diameter.
Application: On machines where linear motion is found. Their use on guide rods, for example, in place of plain sliding bearings which previously had to be used, will afford an extremely long life of exact precision alignment, as the near zero friction eliminates wear as well as the possibility of binding or chatter.

Circle 153 on Reader Service Card



Flowmeter

Minneapolis-Honeywell Regulator Co.
Philadelphia, Pa.

Designation: Potter-Brown flowmeter.
Application: Accurate flow measurement of liquids and gas; capable of handling fluids under pressures up to 20,000 psi and temperatures ranging from −269 C to 1200 F. Used for laboratory work as well as for industrial flow and automatic control applications.

Circle 154 on Reader Service Card

PUMPS

5000 PSI PUMPS

Rugged, high-pressure, high-volume pumps of hydraulically balanced axial piston design, for circuits developing up to 5000 psi. Constant or variable volume. Three sizes; volume capacities, 10, 20 and 35 gpm. Four types of volume control —handwheel, pressure-compensating, stem, or cylinder. Face, flange or foot mountings. Catalogs P-4-1, P-4-2, P-4-3

2500 PSI, 9 GPM PUMPS

Compact, economical constant-volume pumps of high efficiency. Hydraulically balanced axial-piston design. Three models offer capacities ranging to 3000 psi, 1800 rpm, 9.5 gpm. Catalog P-4-10

MOTORS

HIGH-TORQUE, FLUID MOTORS

Powerful, high-torque, axial piston type. Three sizes; torque ratings up to 5585 inch-pounds, or about 160 hp. Speeds to 2000 and 3000 rpm. Compact — largest size only about one foot in diameter. For circuits to 5000 psi. Catalog FM-3

COMPACT FLUID MOTORS

A fixed-stroke axial piston motor with high torque of 510 inch-pounds maximum — about 24 hp. Operates at maximum 3000 rpm; pressures to 2500 psi. Small, compact, efficient. Catalog FM-2

CONTROLS

¼" to 1½" DIRECTIONAL CONTROLS

Rugged, hydraulically balanced, 4-way valves for all requirements to 5000 psi. Seven standard spool combinations; threaded or subplate body types. Seven types of controls for valve operation — manual, hand lever, mechanical stem or cam, hydraulic pilot with or without throttle control, and single or double electric solenoid. Catalogs VD-3, VD-2, VD-4

POSITIVE PILOT OPERATED 4- WAY VALVE

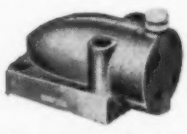
A solenoid-controlled 4-Way Valve that eliminates spool-sticking during long, high-pressure holding cycles. System pressures shift valve spool; solenoid operates pilot valving only. Catalog VD-1-1

¾" to 2" PRESSURE CONTROLS

Denison relief, sequence and unloading valves provide closer control of system pressure with low differential between opening and closing pressures. Available in three pressure ranges for circuits developing up to 5000 psi. Choice of threaded body, subplate, or flange-type mountings. Catalog VR-2A

SURGE DAMPING CONTROL

Prevents destructive pressure shock in high-pressure hydraulic systems. Small, compact, light in weight . . . does not interfere with normal function of other hydraulic components. Adjusts automatically to any working pressures; cannot slow down cycling time. Industrial and Aircraft models — ¼" to 1" Catalog VS-1



PRESSURE REDUCING VALVES

For reduced pressure in secondary circuits without surge or fluctuating pressures caused by higher pressures of primary circuit. New Exclusive design features. For circuits developing up to 5000 psi — 20 gpm to 65 gpm. ¾", 1¼", and 1½" sizes. Threaded, flange or subplate mountings.

DENISON HydrOILics

for circuits developing up to

5000 psi

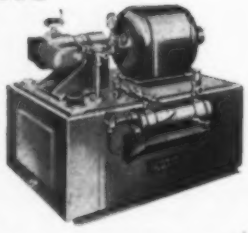
"The Finest Money Can Buy!"

The typical Denison HydrOILic Pumps and Controls shown here have proved their *extra* capacity for continuous, heavy-duty service. Many are built for 5000 psi duty, yet cost no more than other makes of lower rating.

Comparison will prove to you why more and more users, year after year, insist on Denison HydrOILic Pumps and Controls for circuit needs of every type. *Write for bulletins covering your needs.*

The DENISON Engineering Co.
1166 Dublin Road, Columbus 16, Ohio

PUMPING UNITS



SMALL SERIES

Self-contained, vertically mounted units for 2 to 11 gpm requirements. Single-panel assembly of operating components. 15 models cover any circuit need from 400 to 3000 psi. 16 to 35-gallon reservoir capacities. Automatic water-cooled oil coolers available for heavy, continuous service. Bulletin PU-3

LARGE SERIES

High-pressure pumping units in 22 models for circuits up to 5000 psi. Axial piston pumps. Constant or variable-volume delivery of 10, 20 and 35 gpm . . . volume control by handwheel, stem, or pressure compensation. All operating components mounted on reservoir top. 2-pass automatic heat exchangers, available for extra heavy duty. Bulletin PU-4

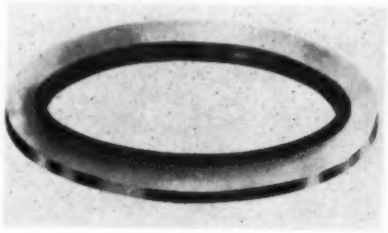
Face-to-Face Seal

Precision Rubber Products Corp.
Dayton, Ohio

Designation: Dyna-Seal

Application: For sealing flat surfaces, bolt heads, rivet heads, flanges and special fittings. No grooves are required. Seals all pressures against water, all types of petroleum products, many other fluids and gases.

Features: Comprises a synthetic rubber sealing member bonded to a steel ring; one piece simple assembly; provides a lock washer action; leakproof sealing up



to 10,000 psi; temperature range −65 to +250 F.

Sizes: To seal 3/16 to 1 1/8 diameter rod.

Circle 155 on Reader Service Card

One Piece Molded Piston Seal

Farris HydroSeal Corporation, Palisades Park, N. J.

Design: While similar to conventional diaphragm construction, the HydroSeal utilizes a peripheral bead for pressure tightness, being substantially a cylindrical form of rubber to stretch, rather than flex as in the

diaphragm. The stroke required is designed into the HydroSeal by the stretching or elastic motion. Supported by a metallic backing, i.e., the piston or ram, there is no tendency to rupture, so that high pressures, equivalent to pressures used on pistons, can be applied.

Applications: The HydroSeal can be incorporated in the design of pneumatic and hydraulic motors, glands, shaft seals, valve seals, cylinders, pumps, brake mechanisms and many other devices. It is available in natural rubber, Buna-N, Butyl and other synthetics to meet special applications.

Circle 156 on Reader Service Card

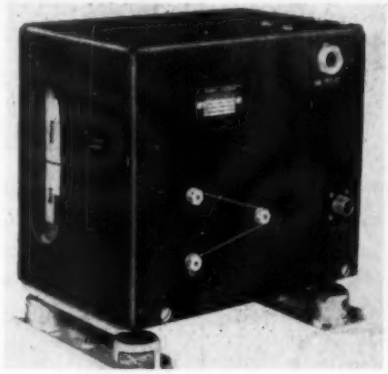
Pressurizing Kit

Lear Inc., Romec Division
Elyria, Ohio

Designation: Model RR-9470

Application: Air pressure in aircraft hydraulic oil tanks is maintained with this new pressurizing kit. The unit is specifically used to prevent cavitation in engine-driven hydraulic pumps by compressing air in the oil tank.

Operation: Operates efficiently at high altitude, with capacity of 100 cu in per min. at 35000 feet. Intermittent operation fully automatic. Pressure is set to start pumping at 7 to 8 psi gage and to stop pumping at 9.75 psi maximum. Electrical receptacle connects to 27 v, dc power source.



Construction: Comprises a 30 cu. in. silica gel dehydrator and a Type Q-1 air compressor; check valve in the outlet port prevents back flow when the pump is stopped; pump is constructed of self-lubricating parts; total weight 9.5 pounds.

Circle 157 on Reader Service Card

DURAMETALLIC
Hydraulic Equipment Packings

"The Packing That is Engineered For the Job"

DURAMETALLIC STYLE B-110
HYDRAULIC EQUIPMENT PACKING

Submit Your Packing or Sealing Problems to Us

A better packing for your sealing dollar — because Durametallic's special resilient core packings provide reliable sealing with minimum adjustment on high and low pressure hydraulic equipment.

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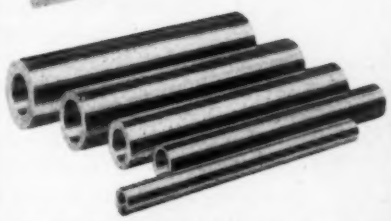
KALAMAZOO, MICHIGAN

Promet Bars Stand Up Where the Going Is Tough!

PROMET
THE Engineered BRONZE

CORED & SOLID BRONZE BAR STOCK



Made from Promet No. 6, an outstanding leaded bearing bronze noted for its free machining properties. Unbelievably great resistance to heat and wear. Will not burn, seize, pound out.

PROMET'S HIGH SAFETY FACTOR IS YOUR INSURANCE AGAINST BEARING FAILURE!

Tougher, harder and stronger, it resists shock loads and withstands high compressive forces and will not cut or stick to the shaft under ordinary operating conditions. There is no seizing, no scoring—just smooth, quiet operation. Will not powder under the most severe conditions of service. When lubrication fails temporarily, Promet carries on safely until proper lubrication can be restored, affording protection against production shutdowns.

PROMET FULLY MACHINED BARS SAVE YOU TIME, TOOLS AND MONEY!

Completely precision machined inside, outside and on the ends, yet sufficient stock remains for the finishing cut. Can be machined at speeds of more than 500 feet per minute—more than double those of phosphor bronzes. This complete machining insures you against subsurface defects sometimes found in rough cast bars. A considerable amount of metal has already been removed—metal which you would be purchasing if you used rough bars. Every bar is absolutely concentric.
Available round, hexagon and square, in 13-inch lengths, rough cast.

MONEY-BACK GUARANTEE

of longer, superior service and lower maintenance cost.

FREE ADVISORY SERVICE

Our competent design and engineering staff will be glad to assist you in solving your special bearing problems.

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Please send free literature on Promet Cored and Solid Bronze Bar Stock.

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Sperry

accurate remote control

A self-contained, hydraulic control, that delivers immediately to the receiver any force applied to the transmitter. Being completely independent of outside sources of power and due to the incompressibility of the hydraulic oil, the Sperry Remote Control System assures instantaneous precision operation of a remote mechanism.

WRITE FOR DESCRIPTIVE LITERATURE

SPERRY PRODUCTS, INC.

DANBURY, CONNECTICUT

REPRESENTATIVES IN PRINCIPAL CITIES

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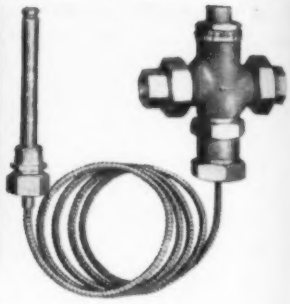
Sterlco

Series 150E

TEMPERATURE CONTROL



Keep oil temperature constant with this compact, self-contained, completely automatic, low-cost unit installed in your heat exchange system. Eliminate the human element at the cooling valve. Remember, oil too hot means slippage . . . too cold means sluggish operation and wasted cooling water.

Send for complete details.

MOUNTS AND OPERATES IN ANY POSITION

UPSIDE DOWN

AT ANY ANGLE

HORIZONTAL

UPRIGHT

MANUFACTURERS OF TEMPERATURE CONTROL EQUIPMENT SINCE 1916

INDUSTRIAL CONTROL DIVISION

STERLING, INC.

3742 N. Holton Street • Milwaukee 12, Wis.

IF REQUIRED . . .

Order immediately for prompt delivery.

Two Weeks Delivery

on Nominal Orders for

VALVAIRS

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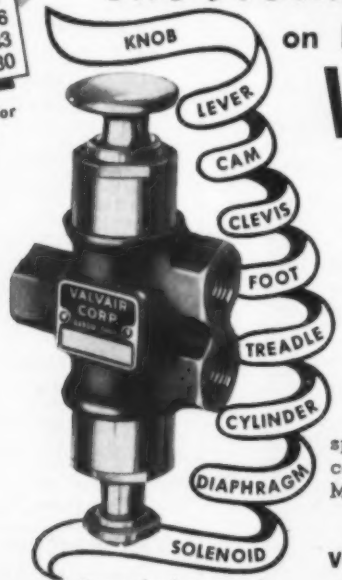
VALVAIR DIVERSATILITY



3-way, knob-operated air control valve.

• Valvair Diversatility is an exclusive, original form of standardization. Five basic bodies permit incorporating any one (or two) control assemblies with a standard valve body. Unique Valvair advantages enable us to speed your order at no extra cost. . . Sizes: ¼" through 1". May we fill your orders *now?*

Get new Bulletin "A-10".

VALVAIR CORPORATION

Affiliate: Sinclair-Collins Valve Co.

951 BEARDSLEY AVE., AKRON 11, O.

REPRESENTATIVES IN PRINCIPAL CITIES

Rely Upon Valvair — 2-WAY — 3-WAY — 4-WAY

Engineers' Choice..

BURD HYDRA-SEAL PISTON RINGS

Burd *Hydra-Seal* Piston Rings perform better, longer, in hydraulic cylinder operation. *Hydra-Seal* Rings seat rapidly, positively eliminate gap leakage, offer complete freedom from face leakage with no undesirable pattern of radial pressure. May we submit the benefit of our hydraulic piston ring experience as applied to *your* equipment? There's no obligation.

Let us send you this FREE bulletin on Piston Ring Seals in Hydraulic Cylinders. Write for Bulletin H-2.

BURD PISTON RING CO.

DIVISION OF THE GABRIEL COMPANY

ROCKFORD ILLINOIS

Circle 88 on Reader Service Card

Circle 8 on Reader Service Card

Toggle Switch

Micro Switch
Freeport, Illinois

Designation: Catalog listing 5AT1

Construction: An assembly consisting of hermetically sealed switch with a toggle type actuator; maintains both "on" and "off" positions of the toggle.

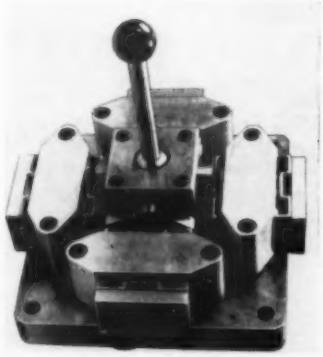
Characteristics: Operating force, 16 oz.; total travel, 40 degrees minimum; weight, .2 lb.; contact break distance, .036 in minimum.

Circle 160 on Reader Service Card

Joystick Operated Valve Assembly

Marton Air Equipment, Ltd., Parkshot, Richmond, Surrey, England

Design: Assembly of four ¼ in. Marton Universal Valve Units, fitted with spring return mechanisms. All ports are tapped ¼ in. B.S.P.



Application: This unit was assembled for the control of a chemical process, through two single acting and two double acting air cylinders. The valves may be operated individually by the joystick which returns to a neutral position when released.

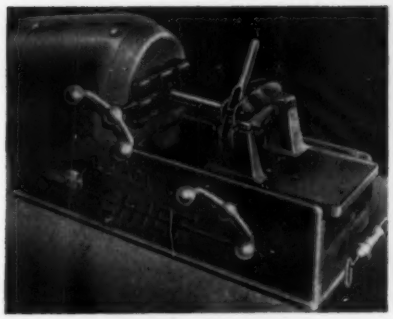
Circle 158 on Reader Service Card

Pipe Threader

Gaines-Collins
Los Angeles, California

Designation: Quijada Chief

Features: Power operated chuck; finger tip control; quick opening die heads; cutter mounted on front jaw housing; flat blade reamer which automatically reams while threading progresses.



Capacity: Pipe range of 3/8 to 2 in.; bolt range of 3/8 to 1 1/4 in. Motor is 115 v ac or dc.

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✻ Whether heavy-duty or light-duty, high-speed or low-speed, from oil burners and blowers to pumps and agitators, there is a LOVEJOY Flexible Coupling to meet your exact requirements. They offer the best obtainable insurance against alignment troubles —dampen and absorb starting torque, vibration and shock of intermittent loads . . . protect motor and driven machine . . . lengthen bearing life.

LOVEJOY Flexible Couplings are compact in construction, durable, and provide excellent resiliency. Bodies carefully machined. Cushions available in materials suited to the particular load conditions . . . can be changed without shutdown. No lubrication needed.

● *Write today for illustrated catalog with handy selector charts.* ➧

Also Mfrs. of Lovejoy Universal Joints and Lovejoy Variable Speed Pulleys.

LOVEJOY FLEXIBLE COUPLING CO.

5037 W. Lake St. • Chicago 44, Illinois

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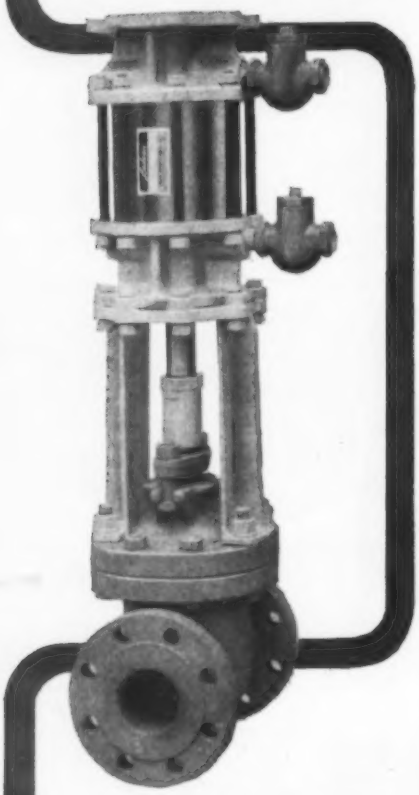
Ledeen
VALVE
ACTUATORS



for POWER OPERATION
and REMOTE CONTROL
of Line Valves

If you require automatic controls or power operation—or if your plant uses many valves in remote or inaccessible spots, you can save manpower and simplify your operations by installing Ledeen Valve Actuators. Adaptable to most any make, size and type of valve to operate against any line pressure, for any fluid medium, with any pressure. Positive, rugged, economical.

Write for Bulletin 512

VALVES • CYLINDERS
AIR-HYDRAULIC PUMPS & BOOSTERS
VALVE ACTUATORS • AIR HOISTS

Ledeen Mfg. Co.
1610 So. San Pedro
Los Angeles 15, Calif.

POST SCRIPTS OF INDUSTRY

NEWS · VIEWS · TRENDS

Jackson L. Parker has been appointed advertising and merchandising manager of the **Graton & Knight Company,** Worcester, Mass. In this capacity, he will also direct sales promotion activities for the G & K affiliates, International Packings Corporation, Bristol, N. H. and Dixie Leather Corporation Albany, Ga. Mr. Parker was formerly advertising and sales promotion manager of the Bijur Lubricating Corporation.

Jackson L. Parker

C. L. Peterson has been appointed general sales manager of the Industrial Division of **Minneapolis-Honeywell Regulator Company.** Mr. Peterson has been regional manager of Honeywell's midwest region in Chicago since January, 1950.

Carl Brown, who has been **Kobe Inc.'s** area service manager for hydraulic sales in Houston, Texas has been put in charge of their Cleveland, Ohio sales office. He replaces D. B. Ross who has resigned to go into business in Tulsa. Kobe Inc. is a division of Dresser Equipment Co. with headquarters in Huntington Park, California.

ACCURATELY INDICATES
Rate of Motion at all Speeds
up to 20,000 per second *without* contact

other uses
Measure acceleration and velocity. Trigger or synchronize cathode ray oscillograph sweep circuit angular position indicator (shaft or fly-wheel), reference marker (degrees, position or dead center). Indicate RPM, operations, cycles or motion at rates in excess of 20,000 per second when used with electronic counters.

Model 3010 U.S. Pat. 2356783

NEW
Electro ELECTRONIC EQUIPMENT IMPULSE GENERATOR

Small low cost electromagnetic pick-up amplifies electrical impulses for counting recurring operations, revolutions, sequences, cycles or motions. It produces a voltage output proportional to the object's rate of speed. And may be actuated by the displacement or vibration of any magnetic material in the field of the pick-up. Such as a slot or keyway in the rim of a wheel or shaft, the teeth in a gear, or any magnetic part on a moving body.

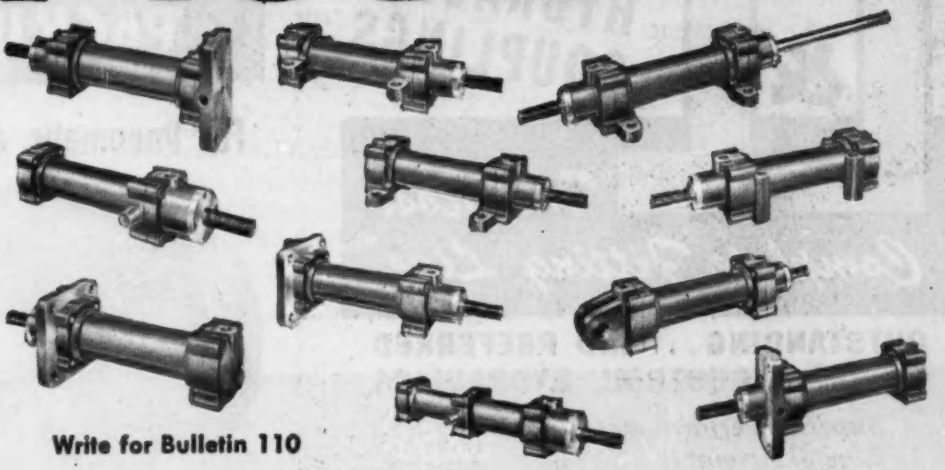
Consult Our Engineers On Your Particular Problem.
Write for Bulletin MP 552 Today!

ELECTRO PRODUCTS LABORATORIES
4501-Hu North Ravenswood, Chicago 40, Ill. In Canada: ATLAS RADIO CORP., LTD., Toronto

FOR YOUR

SERIES "N" HYDRAULIC CYLINDERS

- Long recognized as the finest hydraulic cylinder made.
- No tie rods; ideal for long-stroke applications
- 12 bore sizes, 1" to 8"
- 11 mounting styles; many combination mountings available



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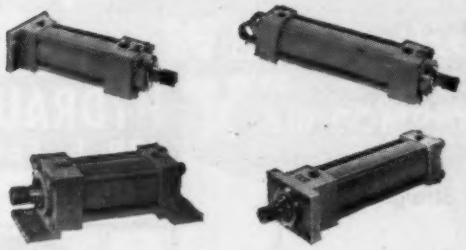
HYDRAULIC

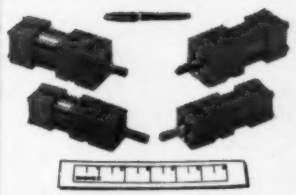
New HANNIFIN "Space Saver" HYDRAULIC CYLINDERS

- Here is a square-type cylinder built to Hannifin's exacting standards
- Especially designed to meet the needs of machine tool builders



Write for Bulletin 111

Series SS—9 Bore Sizes, 1½" to 6" Four popular mounting styles, rugged construction, for pressures to 2,000 p.s.i.



Type U—Pressures to 1000 P.S.I. 1", 1¼", 1½" Bores—Ideal for jig and fixture work. Write for Bulletin 112

CYLINDERS

HANNIFIN "CUSTOM" HYDRAULIC CYLINDERS

- Built in quantity for use on customers' products
- Specially designed for each application
- Often the most economical way to buy hydraulic cylinders

Bring us your cylinder problems.

HANNIFIN

Hannifin Corporation, 1155 S. Kilbourn Ave., Chicago 24, Ill.

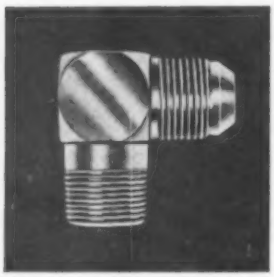
Air and Hydraulic Cylinders • Hydraulic Power Units • Pneumatic and Hydraulic Presses • Air Control Valves

L&L STEEL HYDRAULIC COUPLINGS

"The Most Complete Fitting Line"

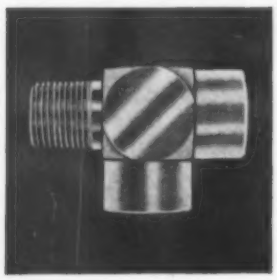
OUTSTANDING... AND PREFERRED ON ALL INDUSTRIAL HYDRAULICS

...Superior Performance
...Ease of Assembly
...Precision Quality
...Large Wrench Flats
...Widest Selection of Shapes and Sizes



JIC FLARED TUBE

- Two or Three Piece
- Sizes ⅛ to 2" Tube
- Square Stock Bodies
- Variable Length Elbows
- Lateral Tube or Pipe Outlets
- Bulkhead Straights – Elbows



PIPE FITTINGS

- Steel-Bar Stock
- 3000 PSI Service
- Dryseal Pipe Threads
- Elbows, Tees, Crosses, Unions, Bushings, and Nipples

MISCELLANEOUS

- Swivel Elbows
- Restrictor Fittings
- Needle Valves
- Ball Check Valves
- Barbed Hose Stems
- Steel SAE 45° Flare Fittings

Write today for Catalog

Representatives in Principal Cities

L&L MANUFACTURING CO.
Since 1937
8088 EAST NINE MILE RD. • VAN DYKE, MICH.

Circle 40 on Reader Service Card

MONOPAK-CARTRIDGE PACKING UNIT!

For Pneumatic and Hydraulic Cylinders

Combines all necessary Packings, Bearings and Rod Wipers into One Compact Unit.

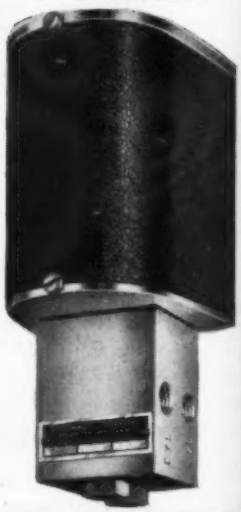
Can be installed or replaced by totally inexperienced mechanics within a few seconds.

Write for Literature

HYDRAULIC ACCESSORIES CO.
439 E. Fort St. • Detroit 26, Mich.

4-WAY SOLENOID OPERATED AIR-VALVE only $32.50

For Fast Operation of Cylinders up to 3" Diameter



Compact sturdy construction, precision engineered for long, uninterrupted heavy duty operation.

Has small, well protected solenoid—operates small cylinders up to 3" dia. and larger cylinders where unusual speeds are not required.

Quantity and O.E.M. discounts. Write for description, discounts, etc.

IMMEDIATE DELIVERY

3-WAY VALVE
Same Design
only $19.80

AUTOMATIC VALVE CO.
37427 GRAND RIVER AVE., FARMINGTON, MICH.

The **Garlock Packing Company** announces the appointment of **Joe H. Dunlevy** as district manager of its Los Angeles office at 2303 E. Eighth Street. From 1919 to 1929 Mr. Dunlevy was a Garlock sales representative operating from Cleveland, Ohio office. Then for two years he acted as a special representative for the vice president in charge of sales. Since 1930 his headquarters have been at Palmyra, New York serving as a consultant on mechanical packing problems for the entire company as well as Garlock's special representative contacting the Army and Navy in Washington, D. C.

Joe H. Dunlevy

C. A. Franklin, Jr. has been appointed western district sales manager of the **New York Belting and Packing Company.** His territory extends from the Rocky Mountain states to the West Coast, from the Canadian border to the Mexican border and the Hawaiian Islands.

William H. Old has joined **The Babcock & Wilcox Company** as director of purchasing. He will be located in the New York office of the company.

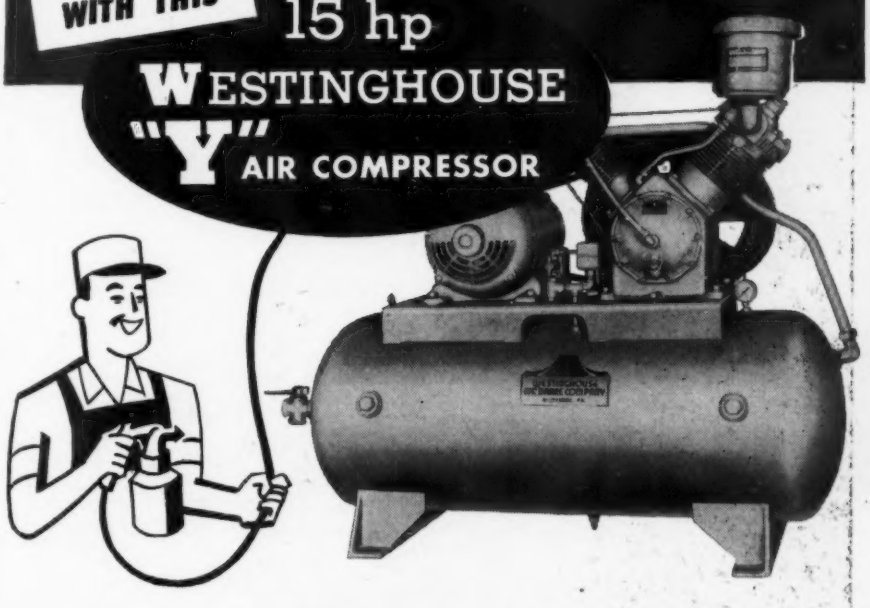
W. S. Shamban & Co., Los Angeles, California, has appointed **Henry A. Traub,** chief engineer, and Frank R. Chaffin, research director. Mr. Traub invented and developed the Teflon spiral back-up ring. He was formerly with Douglas Aircraft Co., Inc. He will direct Shamban & Co.'s engineering activities. Mr. Chaffin was assistant director of research of Specialized Instruments Corp., and will head flurocarbon product research and development.

Robert W. Ayling has been appointed development engineer on the engineering staff of **The Brunner Manufacturing Company** at Utica, New York. For the past five years Ayling has been connected with the Carrier Corporation in Syracuse in the capacity of receiver and compressor engineer.

William A. Traut, formerly chief engineer, Blackhawk Manufacturing Co., has established himself at McAllen, Texas, where he will offer consulting engineer services.

Take care of tomorrow's air requirements **NOW**

WITH THIS 15 hp WESTINGHOUSE "Y" AIR COMPRESSOR



THIS new "big boy" of the Westinghouse "Y" line of Air Compressors is made to order for growing businesses. Equipped with a 15 hp motor and having a displacement rating of 68 cfm, it's big enough to handle that extra equipment you may add next year or the next.

It's built for tomorrow in terms of service life, too. The 15 hp "Y" incorporates all the Westinghouse features that assure long, uninterrupted operation . . . features that include low oil level protection, positive starting unloader, controlled pressure lubrication and thermal overload protection.

For quick, easy changes between continuous and intermittent operation, this Westinghouse "Y" is equipped with dual control. Change-over requires only a turn of the cock handle.

Westinghouse Air Compressors are built to require minimum attention, but when you want service you want it quickly. And you get it quickly from the nearest of 250 distributors and dealers throughout the country.

Remember Westinghouse Air Compressors for the best in design—the best in construction—the best in service.

INDUSTRIAL PRODUCTS DIVISION

WESTINGHOUSE AIR BRAKE COMPANY WILMERDING, PENNA.

CHEMISEAL (MADE OF TEFLON) PACKINGS

NATURALS FOR HYDRAULIC SERVICE

Unaffected by any hydraulic fluid, Chemiseal Packings—made of chemically inert Teflon*—won't harden, soften, swell or shrink in service. Outlast other type packings several times over.

FOR HYDRAULIC VALVES

Try Chemiseal V-Type Packings that seal with low gland pressures and operating torque. Extremely resilient, tough, antihesive—it cannot seize the valve stem, is ideal for either manual or automatically operated valves.

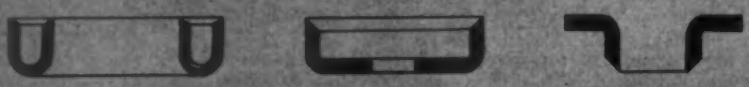
Supplied in sets with square-end Teflon adaptors. Ask for Catalog No. 810-V.

CHEMISEAL BACK-UP RINGS

Protect O-Rings and other packing from extrusion, deterioration and loss of efficiency with Chemiseal Back-up Rings.

They support packing and greatly lengthen its life.

OTHER CHEMISEAL PACKINGS



U-Rings | Cup Packing | Flange Packing

UNITED STATES GASKET COMPANY

FLUOROCARBON PRODUCTS DIVISION

FABRICATORS OF "TEFLON", "KEL-F" AND OTHER FLUOROCARBON PLASTICS

CAMDEN 1, NEW JERSEY

*du Pont's trademark for its tetrafluoroethylene resin.

James F. Walters has been appointed industrial sales engineer for **The Parker Appliance Company,** Cleveland, in the Buffalo territory. A graduate of Pratt Institute, New York, in mechanical engineering, Walters served as an Air Force research and development officer at Wright Field during World War II, subsequently joining the General Electric Company in an engineering capacity. For the past four years, he has been a sales engineer with The General Cable Corporation.

James F. Walters

Robert E. Sheahan has also joined **The Parker Appliance Company** as product development engineer. For the past ten years he has been design engineer for a variety of projects involving General Electric products and military equipment.

Ralph O. Bettison has been appointed field engineer in the Pontiac, Michigan area by **The Bellows Co.,** Akron, Ohio. The territory represented by Mr. Bettison includes the entire county of Livingston and parts of McComb, Oakland and St. Clare counties.

C. S. Vaughn

R. O. Bettison

Clifford S. Vaughn has been named as assistant to **George W. Cook,** manager of The Bellows Co. of California. Mr. Vaughn has been associated with the Bellows Co. of California for the past 19 months as field engineer in the Los Angeles territory. He will make his headquarters at 733 East Pico Boulevard, Los Angeles.

ELECTRO DYNAMIC

INDUSTRIAL MOTORS

Toughened to "TAKE IT"

EBCo-built *U.S.S. Perch* in maneuvers off Alaska. Official U.S. Navy photo.

Industry has learned
what marine engineers
have known since 1880

**ELECTRO DYNAMIC
builds great motors**

To withstand the terrific strains of submarine service, Electro Dynamic motors have long featured *extra-dependable* performance and *extra-rugged* construction to resist stress and prevent twisting and distortion.

E. D. motors for industry, like their famous marine counterparts, are built to stand up under the hardest kinds of uses. Their husky cast frames and housings assure rigidity and resist corrosion. And the special care and superior insulating materials that go into the WINDINGS . . . "the heart of the motor" . . . provide many extra years of dependable, low-cost operation.

There's an E. D. motor for every industrial application. Available in all standard enclosures...1 to 250 h.p. Write today for literature.

E. D. also makes a complete line of Direct Current Motors and Generators. Literature on request.

ELECTRO DYNAMIC • Division of General Dynamics Corporation • Bayonne, New Jersey

AUTHORIZED SERVICE IN PRINCIPAL CITIES

Circle 20 on Reader Service Card

Circle 54 on Reader Service Card

Specify the MONARCH Hydraulic Pressure PUMP for NEW and existing equipment - -

The type TUH (Illustrated)

Features oil reservoir case (with foot mounting bracket), 3 way valve control for single-acting rams, and necessary piping. A completely self-contained control.

Other features of the HY-LO-JACK UNIT

- 1,000 Lbs. per sq. inch pressure.
- Only one (replaceable) internal pump unit.
- Less than one horsepower to operate.
- Mounts on most types of equipment with minimum of time and tools.

Write NOW for complete details to—

MONARCH ROAD MACHINERY CO.
Hydraulic Division
327-29 FRONT AVE., N. W.
GRAND RAPIDS, MICHIGAN

Photoswitch, Incorporated announces the appointment of **John B. Sullivan** as eastern sales manager. Mr. Sullivan has been associated with Photoswitch for several years as sales engineer and prior to this was project engineer for the Raytheon Manufacturing Company.

W. A. Finn has been named assistant general sales manager of **Worthington Corporation.** Mr. Finn, who is returning from Paris, France, where he has been serving as general European manager, will now make his new headquarters at Worthington's Harrison, N. J. offices.

Barco Starts New Plant Construction

Barco Manufacturing Co., whose products include swivel joints for hydraulic applications, is constructing a new plant at 500-530 N. Hough St., Barrington, Ill., for occupancy early in 1953. The new structure will provide 103,000 square feet of floor space for offices, manufacturing, and other facilities, including a cafeteria for employees.

Barco is in its 44th year of continuous operation and has occupied its present plant at 1801 Winnemac Avenue in Chicago since 1920.

IT PAYS TO INVEST IN PROTECTION

Send for Descriptive Literature

HANNIFIN "Air Warden"

Hannifin "Air Warden" safeguards against loss of production time—protects your valuable air-operated equipment three ways.

1. AIR FILTER—removes grit, dirt, scale, moisture, emulsified oil.
2. PRESSURE REGULATOR—keeps pressure where you want it. No danger of pressure build-up with "Air Warden."
3. LUBRICATOR—atomizing type lubricator, can be filled without shutting off air pressure.

Sold separately or in combination (as shown).

HANNIFIN

HANNIFIN CORPORATION, 1155 S. Kilbourn Ave., Chicago 24, Illinois

Bears for.. ..Punishment

SUPER SEAL SCRAPER RINGS

AN 6231A

Hydraulic components can't perform better than the scraper rings with which they're fitted. Specify SUPER SEAL AN6231A for highest precision standards. Approved MIL-S-5049. Made to "gage tolerances." Metal-to-metal fit maintained with minimum interference and breakout pressure, making possible useful life in excess of requirements of Govt. Specs. Write, phone, wire.

AN6228 and AN6229 "V" Ring Adapters

(THAT'S NOT ALL! We're specialists in engineering, development, manufacture of electronic and hydraulic components. Experienced staff, well-equipped shop, ready to go! Write.)

Gadgets, inc.

3629 NORTH DIXIE DRIVE, DAYTON 4, OHIO

Circle 34 on Reader Service Card

Circle 25 on Reader Service Card

L. S. Barksdale announces the incorporation of **Barksdale Valves** and the promotion of **M. C. Nelson** from general manager to vice president and director of the Barksdale organization. In his new position Nelson will direct the expanding sales activities of the corporation, which is now represented in forty major industrial areas.

M. C. Nelson

Lord Manufacturing Company, Erie, Pa. has promoted two key officials of the company in engineering and sales. **George E. Tubb,** who joined Lord as general sales manager in 1949, becomes vice president in charge of sales. **Richard C. Henshaw** becomes manager of engineering and heads up all engineering of the company's products. Mr. Henshaw joined Lord in 1938 as an engineer.

Harry E. Sloan, president of the **Cushman Chuck Company** since 1928, has been elected Chairman of the Board. Mr. Sloan has completed 53 consecutive years of service. **Harry E. Sloan, Jr.,** who has served under his father as vice president and secretary since 1939, now becomes president. **William C. Gaw** has been elected vice president in charge of sales.

J. M. Douglas has been named valve sales manager for the Central region for **Minneapolis-Honeywell Regulator Company.** He will make his headquarters at the company's Cleveland branch office.

The **Cleco Division** of the Reed Roller Bit Company, Houston, Texas, has announced the appointment of Harry P. Lau, Inc., Orlando, Florida; and Ace Equipment and Supply Co., Inc., 436 Irving Avenue, Hillside, Illinois as distributors.

TROSTEL *Engineered* PACKINGS

THREE separate and distinct laboratories to solve your sealing problems

Good packings design requires exact answers to specific hydraulic, pneumatic, or fluid retention problems with rubber or leather.

Supplying these facts is the important function of Trostel research—supplying them out of experience wherever possible; developing new compounds and impregnations where existing materials are found wanting.

The end result is a thoroughly tested design based on known operating data; one that can be produced economically, in quantity, under rigid laboratory control.

We invite you to join the many well-engineered companies who have found these services both indispensable and profitable.

Illustrated bulletin on request.

ALBERT TROSTEL PACKINGS, LTD., Lake Geneva, Wisconsin

Formerly Division of Albert Trostel & Sons Co., Milwaukee, Wis.

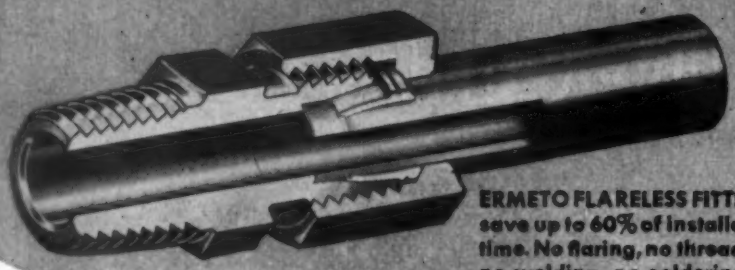
BRANCH OFFICES | NEW YORK • LOS ANGELES • SAN FRANCISCO
SEATTLE • HOUSTON • WORCESTER, MASS.

TROSTEL QUALITY

TROSTEL mechanical packings and oil seals

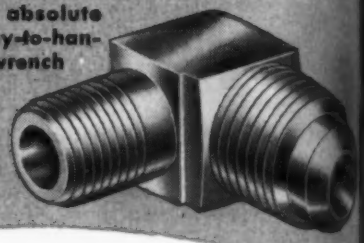
FOR HYDRAULIC CONNECTIONS—FAS

You can't beat Weatherhead's basic economies in installation time and expe



ERMETO FLARELESS FITTINGS save up to 60% of installation time. No flaring, no threading, no welding, no soldering.

EXTRUDED BRASS FITTINGS for absolute uniformity. Easy-to-handle, large, flat wrench pads speed installation.



ALABAMA

Birmingham (4)
Owen-Richards Company, Inc.
1009 Second Avenue North

Mobile
Bearings & Transmissions Supply Co.
505 St. Louis Street

Montgomery
Alabama Bearings Company, Inc.
7 Railroad Street

ARIZONA

Phoenix
Pratt-Gilbert Hardware Company
P. O. Box 2230

CALIFORNIA

Huntington Park
Mahi Steel & Supply Company
3081 East Slauson Avenue

Long Beach
American Wholesale Hardware Company
1500 West Anaheim Street

Los Angeles (54)
Union Hardware & Metal Company
5555 Ferguson Drive

San Diego (2)
Coast Equipment Company
2019-2023 Main Street

San Francisco (3)
The Adam-Hill Company
244 Ninth Street

COLORADO

Denver
Buda Engine Sales & Service

Denver
Hendrie & Bolthoff Company
1635 Seventeenth Street

Denver (2)
Plant Equipment Company
1863 Wazee Street

CONNECTICUT

Bridgeport
H. G. Davis, Inc.
195 Dewey Street

Hartford (6)
Faxon Engineering Company, Inc.
185 Hudson Street

New Haven (7)
The C. S. Mersick & Company
278 State Street
P. O. Box 1690

Stamford
Glauber, Inc.
880 Main Street

GEORGIA

Atlanta (3)
J. M. Tull Metal & Supply Co., Inc.
285 Marietta Street, N. W.

ILLINOIS

Chicago (14)
Meyer-Ekstrom Company
2435 N. Halsted Avenue

Chicago
Shields Rubber Company
564 West Randolph Street

Chicago (6)
Sterling Products Company, Inc.
121 North Jefferson Street

Decatur
Mill Supply & Machinery Company
915 East Wood Street

Peoria (3)
Spence Tool & Rubber Company
1530 North Adams Street

Rockford
Nelson & Storm Tool Supply Company
718 Broadway

Salem
Buda Engine Sales & Service

INDIANA

Evansville
Diamond Supply Company, Inc.
616 N. W. Second Street

Indianapolis (9)
Indianapolis Belting & Supply Co.
30-36 South Capitol Avenue

Indianapolis (9)
Vonnegut Hardware Company
402 W. Maryland Street

South Bend (24)
South Bend Supply Company

IOWA

Davenport (8)
Crane Company
217 E. Second Street

KANSAS

Great Bend
Buda Engine Sales & Service

KENTUCKY

Frankfort
Industrial Supply Company
Holmes Street

Louisville (2)
Uland Rubber Company
N. E. Corner Floyd and Market Streets

Ludlow
Riggs Engineering Company
P. O. Box 133

LOUISIANA

Lake Charles
Norvell-Wilder Supply Company
P. O. Box 1012

New Orleans
Industrial & Marine Equipment Co.
334 South Diamond Street

New Orleans (7)
Standard Supply & Hardware Company, Inc.
822-866 Tchoupitoulas Street

Shreveport
Norvell-Wilder Supply Company
P. O. Box 1586

Shreveport
Standard Brass and Manufacturing Company
1557 Texas Avenue

MAINE

Portland (6)
The Harris Company
188 Commercial Street

Portland
Portland Tractor Company, Inc.
803 Forest Avenue

MARYLAND

Baltimore (2)
Atlantic Copper & Brass Company
114 South Frederick Street

Baltimore (2)
Robins Rubber Division
A. K. Robins & Company, Inc.
Chandler Bldg.

MASSACHUSETTS

Boston
H. G. Davis, Inc.
8 St. Mary's Street

Cambridge (40)
Brown-Wales Company
165 Rindge Avenue Extension

East Walpole
Knox, Incorporated

Fitchburg
The Jennisen Company
87 Putman Street

MICHIGAN

Ann Arbor
Gransden-Hall & Company
424 South Fourth Street

Detroit (27)
Great Lakes Rubber Company
14615 Meyers Road

Detroit (26)
The Charles A. Strelinger Company
149 East Larned Street

Flint (1)
Gransden-Hall & Company
Walnut and Poplar Streets

Jackson
Smith-Winchester Company
140 South Mechanic Street

Pontiac (16)
P. T. Standard Parts Company
P. O. Box 158

MINNESOTA

Hibbing
General Diesel & Equipment Company, Inc.
2521 First Avenue

Minneapolis (16)
Miller Rubber Sales Company
4100 Toledo Avenue South

Minneapolis (1)
W. S. Nott Company
2nd Avenue North & Third Street

Minneapolis (3)
Pheoll Manufacturing Company
1313 Chestnut Avenue

MISSISSIPPI

Jackson
Mississippi Bearings, Inc.
843 S. State Street

MISSOURI

Kansas City (8)
Forslund Pump & Machinery Company
1717-19 Main Street

Kansas City (10)
Mid-States Supply Company
P. O. Box 558

St. Louis (10)
AR-KA Engineering Company
1319 South Vandeventer Avenue

St. Louis (20)
Lincoln Engineering Company
5701 Natural Bridge Avenue

St. Louis (3)
Mill Supply & Machinery Company
2910-12 Washington Avenue

NEW JERSEY

Jersey City (5)
Culbert Pipe & Fittings Company
301 West Side Avenue

Newark (4)
Jarett Compressor & Equipment Company,
275 Central Avenue

NEW MEXICO

Albuquerque
The Harry Cornelius Company
1510 North 2nd Street

NEW YORK

Brooklyn (32)
B. F. Gilmour Company, Inc.
152 Forty-First Street

Buffalo (14)
J. M. Cranz Company
2671 Main Street

Buffalo (14)
T. R. Goldsmith & Son
52 Highgate Avenue

Long Island City (1)
Lincoln Lubricating Systems, Inc.
48-14 36th Street

New York (7)
John B. Astell & Co., Inc.
90 West Broadway

New York (6)
Hydro Pneumatics, Inc.
90 West Street

Rochester (4)
Chapin-Owen Company, Inc.
205-213 St. Paul Street

Rochester (7)
Frank E. Laffan Company
167 Charlotte Street

Schenectady
LeValley, McLeod, Inc.
126-140 Van Guysling Avenue

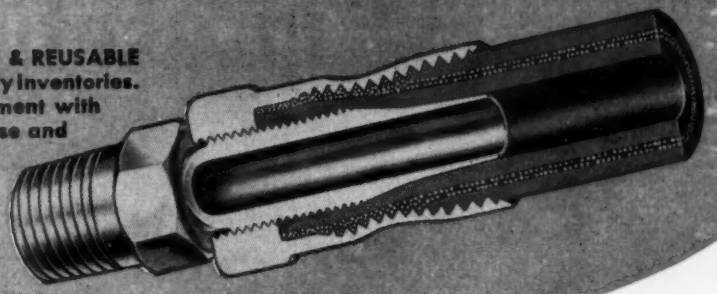
Syracuse (1)
Burns Piping Supply Company, Inc.
415-417 South Clinton Street

Syracuse (1)
Onondaga Supply Company
Industrial Division
344 West Genesee Street

CALL YOUR WEATHERHEAD DISTRIBUTOR

. . . you can't beat Weatherhead's distributors for fast delivery from stock

INDUSTRIAL HOSE & REUSABLE HOSE ENDS simplify inventories. Meet any requirement with bulk lengths of hose and necessary ends.



Syracuse (1)
Syracuse Supply Company
314-18 West Fayette Street

OHIO

Akron (3)
W. J. Gill Company
422 West Exchange Street

Akron (11)
Hardware & Supply Company
475-535 S. High Street

Canton (2)
Canton Supply Company
938 Cleveland Avenue, S. W.

Cincinnati (25)
Mutual Manufacturing & Supply Co.
3286-3308 Spring Grove Avenue

Cleveland (13)
Cleveland Tool & Supply Company
1427-37 West 6th Street

Cleveland (13)
Mau-Sherwood Supply Company
800 Lime Road

Cleveland (15)
The Midwestern Rubber Company
735 Carnegie Avenue

Cleveland (13)
Strong, Carlisle & Hammond Company
1392 West Third Street

Cleveland (1)
George Worthington Company
802-32 St. Clair Avenue, N. W.

Columbus (8)
Vorys Brothers, Inc.
63 E. Goodale Street

Dayton (1)
W. H. Kiefaber Company
40 Keowee Street

Hamilton
W. H. Kiefaber Company
1900 Fair Grove

Marietta
McJunkin Corporation
P. O. Box 607

Massillon
Hardware & Supply Company
625-28 Erie Street, South

North Lima
Hydraulic Power Equipment Company
P. O. Box 431

Toledo (1)
M. P. Wilkins Supply Company
P. O. Box 562

OKLAHOMA

Oklahoma City
Buda Engine Sales & Service

Oklahoma City
Marshall Supply & Equipment Company
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Oklahoma City
Nix Industrial Company
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Buda Engine Sales & Service

Tulsa
Buda Engine Sales & Service
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Tulsa (1)
Marshall Supply & Equipment Company
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Eugene
Woodbury Company
265 Eighth Avenue

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Woodbury Company
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Bell Supply Company
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Norvell-Wilder Supply Company
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WYOMING

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Buda Engine Sales & Service

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WEATHERHEAD

FIRST IN HYDRAULIC CONNECTIONS

What's NEW in useful Free literature

To get your reference copies use the postcard bound in this issue.

HYDRAULIC VALVES AND CYLINDERS . . . Two specification sheets have been prepared by Benton Harbor Engineering Works on their hydraulic control valves and cylinders. Features of the flow control valve which are discussed include surge control, speed regulation and safety. Both double and single acting cylinders in a variety of mountings are shown.

Circle 176 on Reader Service Card

PILOTS AND CONTROLLERS . . . A revised edition of the pilots and controls section of their Climax control equipment catalog, has been issued by Black Sivalls and Bryson, Inc. This section, 110, shows complete lines of time cycle controllers, pressure controllers, vacuum pilots and safety shut-off pilots. The contents are arranged for easy reading and fully illustrated with sectional drawings and photographs.

Circle 177 on Reader Service Card

METAL BONDING . . . Al-Fin Division, Fairchild Engine and Airplane Corporation has finished a complete brochure on the unique process of molecularly bonding aluminum and ferrous metals. This is the first comprehensive piece describing the process and its applications. It contains several pages of basic design information. Applications are widespread and cover the automotive, aeronautical, power generating and general mechanical fields. The brochure contains photos of more than fifty applications where this method of producing bi-metallic components resulted in either a better product or a product produced at reduced cost.

Circle 178 on Reader Service Card

"O" RINGS . . . A 16 page illustrated booklet, "'O' Rings . . . Design, Manufacture and Application" gives brief but comprehensive data on manufacture and application of "O" rings as static and dynamic seals. Prepared by International Packings Corporation, the booklet includes charts on groove machining details for static and dynamic applications, both with and without back up or non-extrusion washers. The properties and characteristics of the basic polymers are outlined. ASTM and AMS specifications and applicable I.P.C. compounds are shown in chart form for ready reference.

Circle 179 on Reader Service Card

LOW PRESSURE HYDRAULIC CYLINDERS . . . Excel Machine & Supply Co. has prepared a booklet which presents the specifications on their line of 750 psi cylinders. Dimensional charts for cylinders having six different mounting styles and bores from 1½ to 12 inches are included. Construction features are detailed with the use of a line drawing.

Circle 180 on Reader Service Card

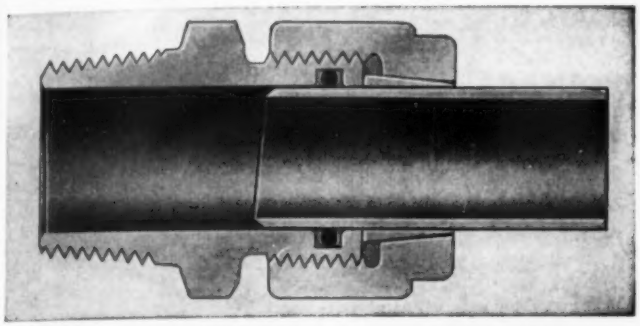
LIMIT SWITCHES . . . A new 24 page, two color, Catalog No. 82 of precision snap-action switches has been published by Micro Switch. This catalog covers safety, limit and interlock switches designed especially for switching ac circuits in industrial and commercial applications. Complete information is included on heavy duty precision limit switches, switches enclosed in metal housings, some of which are sealed against the splash of oil and water. Application ideas are also shown.

Circle 181 on Reader Service Card

AIR COMPRESSORS . . . Monobloc air compressors capable of 2.6 to 5.0 cfm and up to 150 psi are the subject of a specification sheet published by Worthington Corporation. These compressors are designed for operating pneumatic controls, presses, air cylinders and general small capacity uses. Savings in weight over conventional compressor arrangements are effected by the "built-in"motor. This permits light weight with minimum space requirements, yet rugged equipment that is durable. This specification sheet includes discussions of feather valves, aluminum cylinder head, deep finned cast iron

Circle 47 on Reader Service Card

LENZ "O"-RING" TUBE COUPLINGS



Eliminate Flaring . . . Threading Welding . . . Soldering

- Seal and grip are separate
- No metal to metal seal
- No exact tube length necessary
- Not necessary to cut tube square
- No concentration of stresses due to flares or ferrules for tube failures.
- Fast Installation — No tools required but a wrench.

For complete details & Specifications write for bulletin AH 101

LENZ COMPANY

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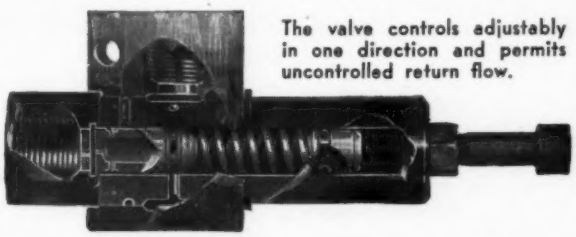
An adjustable FLOW REGULATOR

This newly perfected adjustable Flow Regulator holds at a constant rate even though the pressure fluctuates.



The valve controls adjustably in one direction and permits uncontrolled return flow.

The spring back piston in the housing is mounted in front of the adjustable screw. It carries a calibrated orifice; operates axially on change in inlet pressure so as to increase the throttling action.

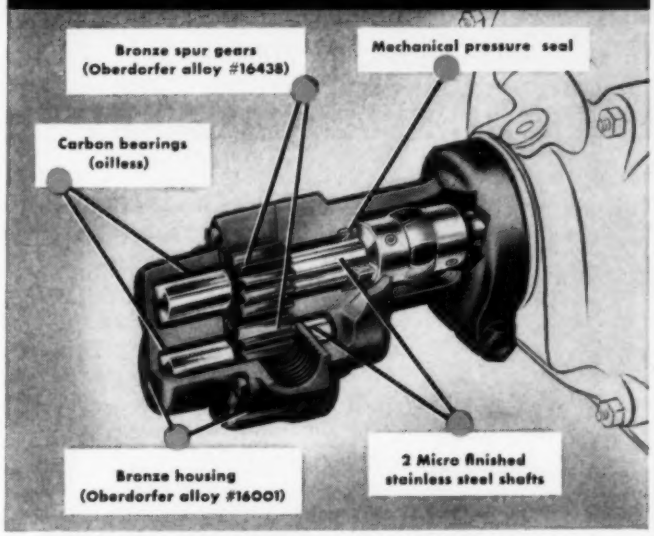
Four sizes, 1/4, 3/8, 1/2, and 3/4 inch. Overall length, 4 1/2 to 7 1/2 inches. Adjustable over a 50% flow range. Maximum pressure is 3000 pounds.

Write for illustrated circular.

WATERMAN ENGINEERING *Company*

725 CUSTER AVENUE • EVANSTON, ILLINOIS

INTERNATIONAL Series II OBERDORFER BRONZE ROTARY GEAR PUMPS


Bronze spur gears (Oberdorfer alloy #16438)
Mechanical pressure seal
Carbon bearings (oilless)
Bronze housing (Oberdorfer alloy #16001)
2 Micro finished stainless steel shafts

Close coupled motor driven units for liquid transfer where space is at a premium.

International Series II Pumps have all-bronze housings and gears, oilless carbon bearings, micro-finished stainless steel shafts (± 25/100,000 of an inch) and are powered by heavy-duty 1/3 h.p. motors* equipped with thermal overload protection.

They are intended to be used wherever a liquid has to be moved from one location to another in quantities up to 240-gallons per hour at pressures from 0 to 100 lbs. per square inch.

International Series II Pumps are adaptable for a wide variety of industrial and chemical applications where a corrosion-resistant pump is required and space is limited. Their all-bronze body and gears permit use with most liquids.

*** Standard 110 v. AC Motor, specially machined for pump mounting**

Capacity Tables Gals. per min. — 1,725 R.P.M. — lbs. sq. in.

Pressure	Pump No. 1½ CCC	Pump No. 2 CCC
0 lbs.	2.10 gal.	4.10 gal.
25 lbs.	1.83 gal.	3.67 gal.
50 lbs.	1.67 gal.	3.17 gal.
75 lbs.	1.58 gal.	2.83 gal.
100 lbs.	1.50 gal.	——

Dimensions (Pump Only)

Pump No.	Pipe Size	Height	Width	Length
No. 1½CCC	3/8"	2 7/8"	2 11/16"	4 3/4"
No. 2CCC	3/8"	3 11/16"	2 3/8"	4 7/8"

Pump No. 1½ CCC — Pump head only.....$20.00
Pump No. 2 CCC — Pump head only.....$22.50

Complete units with 1/3 H.P. 110 volt AC thermal overload motors.....prices on request

Industrial Pump Div., Oberdorfer Foundries, Inc.
5210 Thompson Rd., Syracuse, N. Y.

See our catalog in Sweet's PRODUCT DESIGN File

Pathon

Series RH 2000 P. S. I.

HYDRAULIC CYLINDERS offer you MORE

DURABILITY—On all applications Pathon RH Series Cylinders offers you a "Plus Factor" in durability—you get greater fatigue life . . . less maintenance trouble—**and extra capacity for shock loading.**

COMPACTNESS—The use of a single screw thread for attaching heads to barrels, eliminates the bulkiness inherent in keeper-ring and bolt-type cylinders. You get maximum strength in a minimum of space.

Pathan Series RH Hydraulic Cylinders are available in capacities up to 3000 P. S. I.—for special application.

Write for Bulletin #17

The cylinder selector will help you specify the exact characteristic you want in choosing your Pathon Series RH Hydraulic Cylinder Assembly—

PATHON VALVES—We offer you a complete line of Hydraulic Remotely Operated Directional Control Valves.

PATHON PNEUMATIC CYLINDERS — We manufacture seven standard models of Double Acting Air Cylinders which will meet the great majority of your requirements.

HYDRAULIC CYLINDERS—VALVES

Pathon

MANUFACTURING CO.

3821 Pacific Ave.

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cylinder, aluminum crankcase, counterbalanced crank, oversized main bearings, bronze precision fitted connecting rod, full floating steel wrist pin and heavy duty high starting torque capacitor type motor.

Circle 182 on Reader Service Card

POLYPHASE INDUCTION MOTORS . . . Bulletin 37-200, issued by The Electric Products Company, describes large wound-rotor and squirrel-cage polyphase induction motors. Twenty-four photographs on six pages show many special designs of high horsepower motors. Available in open drip proof, drip proof full protected, splash proof, self-pipe ventilated and separately forced ventilated housings, these motors are well suited for hydraulic pump drive applications on large installations. These motors are custom-built to suit your application.

Circle 183 on Reader Service Card

LEAKPROOF LOCK WASHER . . . Seloc, a three purpose washer, made by Dowty Seals Limited, is described in a 4 page bulletin. A star type lock washer around which there is molded a sheath of synthetic rubber, the Seloc dimensions are tabulated in chart form.

Circle 185 on Reader Service Card

"SELF STARTERS" ONLY WANTED!

Rare Opportunity for Design and Development Engineers

Please Check These:

- ☐ If you are a self starter —
- ☐ If you are tired of being chained to a drafting board —
- ☐ If you are discouraged and disappointed with your present working conditions and future opportunities —
- ☐ If you have a Degree in Mechanical Engineering —
- ☐ If you want to be an individual and not a number in a War Baby plant —
- ☐ If you are looking for Security in a well established small company with a long range future —
- ☐ If you want to share in the profits gained from your abilities —
- ☐ If you are seeking freedom of opportunity to express yourself —
- ☐ If you like to follow an idea through from conception to finished product, including field work and laboratory testing —
- ☐ If you like country life, only a few miles from Los Angeles, among the Orange Groves —

Then YOU are the man WE are looking for!

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Circle 9 on Reader Service Card

Last Word in...

ENGINEERED HYDRAULIC DELUXE

Package Units

"If it's Hydraulic, Century Designs & Builds Them"

We specialize in 30 to 500 gal. reservoir units with any makes or combinations of the commercial lines of pumps and valves to meet your specs.

We modernize your present equipment in use now; let us propose our manifolded valve mounting panels to cut down-time, by eliminating cause.

Our units were designed to meet or to surpass all "J.I.C." standardizations and not copied from other existing similar power units.

Several Styles from Stock—Write for Details

CENTURY HYDRAULICS, INC.

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Depend on DARCOID O-RINGS— for guaranteed performance!

Walter Kidde & Company, Inc., Belleville, N. J., industry-leaders in CO_2 fire fighting equipment, uses Darcoid O-Rings in trigger finger control mechanism where dependable sealing is a MUST.

Take advantage of Darcoid's complete O-Ring service facilities—immediate delivery from complete stocks!

• *Write or phone for design and installation data and comprehensive O-Ring Catalog.*

THE DARCOID COMPANY

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Authorized Distributor for The Goshen Rubber Company on all Specification Molded Parts

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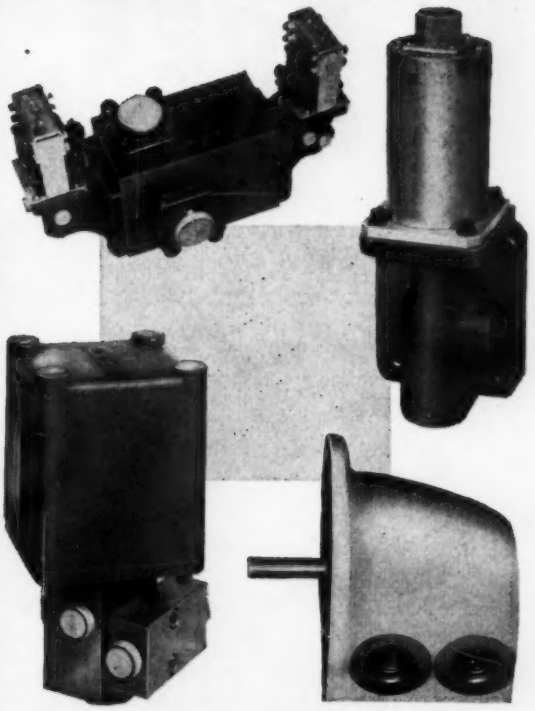
SUPERDRAULIC

PUMPS • VALVES • TRANSMISSIONS • TEST STANDS • REMOTE CONTROLS



HYDRAULIC VALVES

RELIEF — CHECK — SEQUENCE
PROPORTIONAL — PRESSURE REDUCING
TWO WAY — FOUR WAY

We manufacture highest quality standard and special valves of all types for use with hydraulic pumps in power units and hydraulic equipment for all applications.

Write for our new catalog

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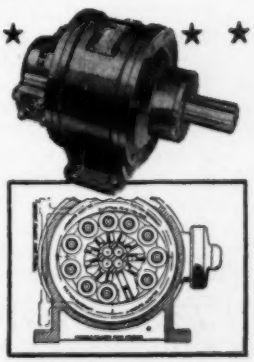

FAMOUS SUPERDRAULIC HIGH PRESSURE PUMP

Develops up to 60 H.P. at 5,000 P.S.I. Let us quote on your requirements.

Superdraulic CORPORATION

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...PACKING DATA FILE

helps you select the right leather packing for most applications

Rhoads Tannate Packing Data File contains a handbook on the design and applications of mechanical leather packings; specifications sheet on Tannate Packings; a special packing engineering form. All material is enclosed in a handy, 9 x 12 file folder for ready reference. Illustrates and describes Tannate U, Vee, Cup and Flange Packings.

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Tannate® CUP-U-VEE AND FLANGE PACKINGS
HYDRAULIC DISCS AND WASHERS

250 YEARS PRODUCING FINE LEATHERS

J. E. RHOADS & SONS
PHILADELPHIA • NEW YORK
CHICAGO • ATLANTA

MANOMETERS . . . Trimount Instrument Company have issued a bulletin on their Red Line Manometers. Illustrated are their well type manometers, absolute pressure manometers, U-tube manometers, indicating flow meters, orifice flanges and plates.

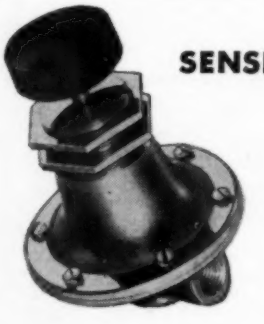
Circle 187 on Reader Service Card

AIR HOSE COUPLINGS . . . Bulletin MLB-452 issued by Hose Accessories Co., describes a new and improved product recently added to the Le-Hi line of hose couplings. Series 900 brass long shank hose couplings are constructed of machined brass bar stock. This method of construction produces an absolutely leakproof and non-porous hose coupling assuring maximum strength. No costly pressure losses or expensive shutdowns. Details as to available sizes are also included.

Circle 188 on Reader Service Card

THREE-WAY SOLENOID VALVES . . . Used for both air and water applications, the M-3 type valve is described in Bulletin 493 available from Skinner Electric Valve Division. The bulletin includes a cross-sectional drawing of the valve which illustrates the accompanying explanation of operation. Electrical and dimensional data are tabulated and flow curves are graphed.

Circle 189 on Reader Service Card



SENSITIVE TO A "TOUCH"

STABLE

DRIFT-FREE

⇨ CONO
AIR PRESSURE REGULATOR

The Cono Precision Regulator is ideal for "dead-end," or small volume flowing service. Responsive to setting changes as small as *five thousandths psi.* Holds set pressure regardless of vibration or normal upstream pressure variations. Streamlined design, all brass and stainless steel. Styles for flush panel or line mounting. Available in ¼" pipe size, in a variety of spring ranges from 0-5 to 0-125 psi.

BULLETIN PH-10.

CONOFLOW CORPORATION
2100 ARCH ST.
PHILADELPHIA 3, PA.

Cono-Controls

CC-115

Circle 69 on Reader Service Card

Circle 13 on Reader Service Card

How To Assemble Threaded Tube Fittings

Continued from page 62

wrench until the first pronounced solid feeling is encountered. From that point, apply a one-eighth turn, maximum. If leakage occurs, disassemble and inspect the fitting and flare before applying more torque.

Size	*Dash No.*	*Thread Size*
1/8	2	5/16-24
3/16	3	3/8-24
1/4	4	7/16-20
5/16	5	1/2-20
3/8	6	5/8-18
1/2	8	3/4-16
5/8	10	7/8-14
3/4	12	1-1/16-14
1	16	1-3/8-12

FIG. 5 SAE Thread Sizes

Size	*Torque Copper Tubing*	*Torque Soft Steel Tubing*
3	55 in/lbs	70 in/lbs
4	65 in/lbs	90 in/lbs
5	80 in/lbs	120 in/lbs
6	125 in/lbs	175 in/lbs
8	250 in/lbs	350 in/lbs
10	350 in/lbs	450 in/lbs
12	500 in/lbs	600 in/lbs

FIG. 6 Torque Table for SAE Brass Flared Fittings

Then tighten to seal if the fitting is not defective and the flare is within tolerance. See Part 3 in the September issue for tubing tolerances.

SAE flared fittings have been widely used in automotive, refrigeration, marine and industrial applications. In brass, they are well suited for such usage where low pressures (up to 1000 psi) are encountered. In steel, they will give satisfactory results up to 3000 psi.

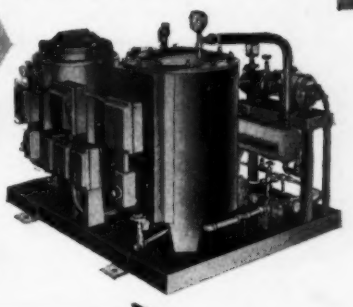
Present trends in standardization are tending to limit, and perhaps eventually, to eliminate this 45 degree flared fitting. It is being superceded by the AN-JIC flared fitting in industrial piping.

Part 5 will continue discussions of other types of flared fittings.

Circle 87 on Reader Service Card

Restores used hydraulic oil to like-new condition

HOFFMAN OIL CONDITIONER



Removes soluble and insoluble impurities
Capacities from 25 to 600 g.p.h.

Protects your hydraulic equipment—lengthens oil life without high maintenance cost of centrifuges. The Hoffman Oil Conditioner consists of a cartridge filter and vaporizer, mounted on a common base, portable if desired. Complete with all necessary electric and pump connections. Only two moving parts—no steam or water connections. Write for technical bulletins.

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U.S. HOFFMAN MACHINERY CORPORATION
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NEW SKINNER SOLENOID VALVE
EXPLOSION PROOF TYPE X5

THE new Skinner X5 Solenoid Valve is basically the same as the widely accepted and tested V5, but modified to a construction that is Underwriters' approved for Class I, Group D hazardous locations. Small size and lightweight features are retained, and the X5 is low in price because of the many parts which are interchangeable with other Skinner valves. Rating is 10 watts max.; soft, spring loaded seals prevent leakage; internal parts are stainless steel; wide variety of port locations in 1/8" and 1/4" size; most types available for metering; for AC or DC in a wide range of voltages and frequencies; can be mounted in any position; supplied as two-way normally open or closed, three-way normally open, closed or directional flow. *Write today for details!*

SKINNER ELECTRIC VALVE DIV.
THE SKINNER CHUCK COMPANY
142 Belden Ave., Norwalk, Conn.

Bonnot Company Opens New Hydromotor Division

Hydromotor, Inc., formerly of Orrville, Ohio, has been acquired through purchase of all outstanding stock by the Bonnot Company, of Canton, for over 60 years engaged in the design and manufacture of special machinery.

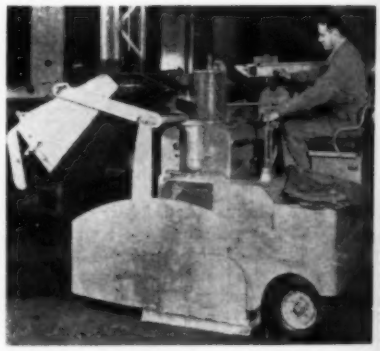
"Hydromotor" is the name given to a line of reciprocating rotary torque actuators employing air or oil.

A new division has been set up for the development and expansion of the Hydromotor line. While the range of sizes originally was limited to three standard models, with ratings of 10,000 to 115,000 inch pounds of torque (at 1,000 psi oil pressure), Bonnot has extended the line to include a variety of larger and smaller standard units, as well as special units for serving unusual requirements.

Established distributors are serving the trade in many industrail areas, with new channels of distribution being set up in areas not yet covered. Engineering service on special projects is carried out in Bonnet laboratories in Canton, Ohio.

Lift and Dump Load in 18 Seconds

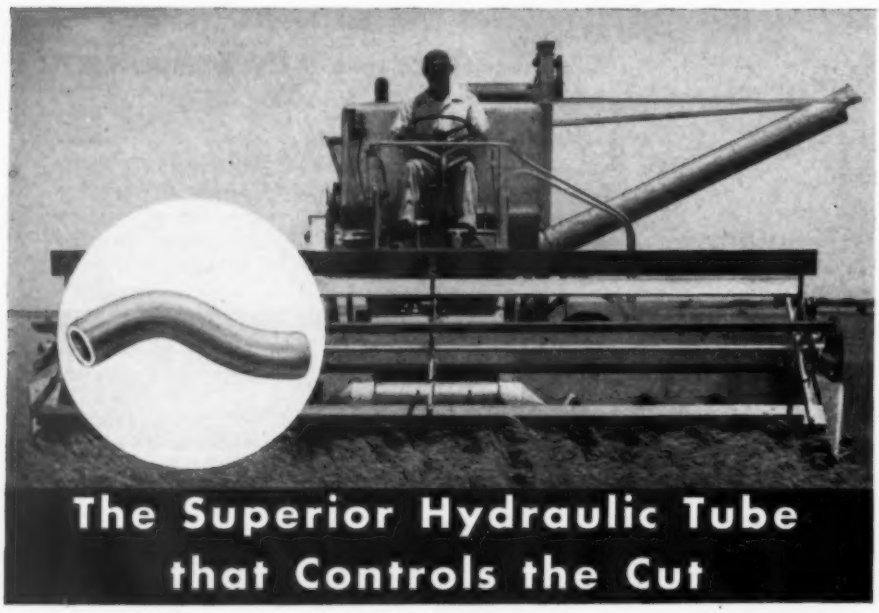
Hydraulic controls are used on this floor cleaning machine for raising and lowering the 36 inch rotary steel wire brush and the dirt hopper. A clevis mounted cylinder, actuated by a lever operated valve, can lift the loaded hopper to a 35 inch clearance and then dump the load all in 18 seconds. The gear type hydraulic pump is powered off the main drive engine.



BY PUSHING A LEVER, the operator of this, hydraulically equipped floor scarifying machine can lift and dump a ¼ ton load of soilage in 18 seconds. The loaded hopper lifts to a 35 inch clearance, and then dumps directly into a trash disposal box. This one man scarifier has been developed by the G. H. Tennant Company of Minneapolis for cleaning large trucking aisles.

Powerful scarifying and cleaning action is provided by the 36 inch steel wire brush which shears away hard packed layers of dirt, oil and metal cuttings and throws the loosened grime into a 10 cubic foot hopper. At the same time an 11 inch, high volume, fan draws lighter dirt into a fabric bag.

On this mobile industrial machine a hydraulic system provides a space saving, economical power source for positioning and unloading.



Pictured above is a Gleaner self-propelled . . . and a Superior Tube that solved a problem for the Gleaner Harvester Corporation, of Independence, Missouri, who builds the combine.

On this machine the entire harvester platform, including cutter and auger is raised and lowered to operating heights hydraulically. While advanced engineering and quality production make this combine quiet and smooth in operation, considerable vibration is necessarily present . . . with consequent probable failure of ordinary hydraulic tubing.

That's why this manufacturer came to Superior for Hydraulic Quality low carbon steel tubing . . . to get a better product that will give their customers better, longer service.

If you have a need for Hydraulic Tubing for a tough job that must be well done—check with Superior. For complete information, free literature and the name of your nearest Superior Distributor, write the Superior Tube Company, 2030 Germantown Ave., Norristown, Pennsylvania.

Superior
THE BIG NAME IN SMALL TUBING
All analyses .010 to ⅜" O.D.
Certain analyses (.035" max. wall) up to 1⅜" O.D.

Circle 3 on Reader Service Card

AIR-MITE Air Cylinders

Single Acting **Double Acting**

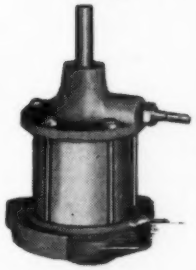
MICRO

CLEVIS

Worth Their Weight in GOLDen Man-Hours

Save time, spoilage, cost . . . speed production . . . reduce fatigue . . . on all drilling, reaming, tapping and processing jobs. Available in 1", 1½", 2¼", 3", 4" and 5" diameters; stroke length optional. Single or double action; all mountings.

Write for complete catalog of Air Cylinders and Air Arbor Presses.



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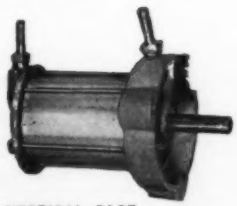
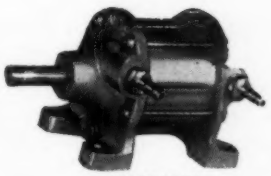


VERTICAL FACE



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Has 3-1/2 GPM capacity at 600 PSI. Motor is 1½ HP, 24V, D.C. Will operate on either 12 or 32V, DC current. Has built-in relief valve adj. to 1500 PSI. This unit ideal for hyd. lifts, portable loaders, etc. 19.50

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Heavy duty, G.E. Gear Head motor. 2 HP, 24V. DC, 125 amp., reversible motor drives a reduction gear unit giving 36 to 1 ratio at take-off. Also will operate on 6 or 12 volts.

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36 to 1 G.E. (306 shaft RPM)

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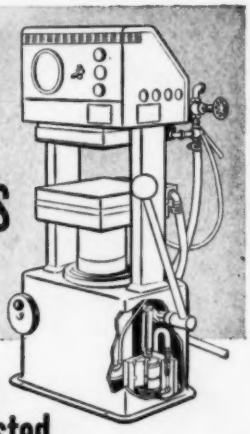
TEST RESULTS . . . .

PALMETTO® G-T RING CHOSEN BY MAKERS OF PRECO PRESS



Gives best performance of all packings tested

Preco Incorporated of Los Angeles, Calif., makers of the 20 ton hand operated Preco Hydraulic presses, needed a reliable packing . . . a packing which would hold 3200 psi at 140 F. Packing rings were to be installed in grooves cut in cast iron pistons operating at low speeds in honed mild steel cylinders . . . a lightweight motor oil to be used for hydraulic fluid.

Make Their Decision

C. L. Rector, Test Engineer, and Paul Anderson, Product Engineer, ran exhaustive trials on many packings . . . checked results—and made their decision: Palmetto G-T Ring!

Why the Palmetto G-T Ring

The Palmetto G-T Ring's ability to seal without extrusion is outstanding. Performance without extrusion has been obtained with pressures as high as *50,000 psi.*

Its principle of operation is unusually simple:

HOW PALMETTO G-T RINGS WORK . . .

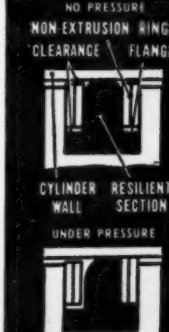


Fig. 1 shows Palmetto G-T Rings with no pressure applied. CLEARANCES between the FLANGES of the RESILIENT SECTION and the laminated plastic NON-EXTRUSION RINGS, as well as between rings and CYLINDER WALL prevent low pressure friction.

Fig. 2 indicates how the RESILIENT SECTION flows under pressure, causing the FLANGE to swell under the rings on the low pressure side, bringing them to bear on the CYLINDER WALL. CLEARANCE spaces are closed, preventing any extrusion of the packing material. The piston, forced to a central position, will move forward without binding or jamming and with no damage to packing or CYLINDER WALL. Elimination of extrusion of the packing material is the outstanding feature that makes Palmetto G-T Ring Packing the ultimate in seals.

If a superior packing can solve a knotty design problem in your research department, contact Greene, Tweed for cooperative assistance. Write for literature on all Palmetto Packings.

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packing more performance into every application

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REQUIRE *Hydraulic* POWER MOVEMENT

IF YOU FABRICATE MATERIALS, produce parts or build machines, you will find Hydraulics an economical modern source of force for smooth oil-cushioned power movements.

Racine Variable Volume Pumps with interchangeable automatic governors, deliver only the volume of oil needed for the job. There is no waste of "pressure-oil" through relief valves — no by-passing — no wasted horsepower. Racine Oil Hydraulic Pumps *put all of the oil to work* — thus assuring a simple efficient hydraulic circuit with proven installation and operating economies. Capacities up to 70 gpm at 1000 psi.

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OTHER RACINE HYDRAULIC PRODUCTS

Four-Way Valves

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HYDRAULICS & MACHINERY, INC.

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The Bendix Story On Hydraulic Maintenance

Concluded from page 42

and technical data sheets are kept. The visible index record cards and the work sheets used to route daily service work are kept in the office of the general foreman where clerical assistance is available.

Rebuilding Service

The shop area is equipped to rebuild any of the pumps in service in the plant. Rings, vanes and bushings are stocked. While two lines of pumps predominate in numbers, parts for practically any pump work are kept on hand. All the valves in service can be disassembled, repaired and reassembled. Springs, spools, ball seats and other parts are stocked. All members of the maintenance crew are trained to handle any pump or valve repair work.

The pneumatically operated machines and circuits are taken care of by the hydraulic crew. While far fewer in number than the hydraulic equipment, the air circuits are increasing in number. Records and procedures for these machines are similar to the hydraulic machines.

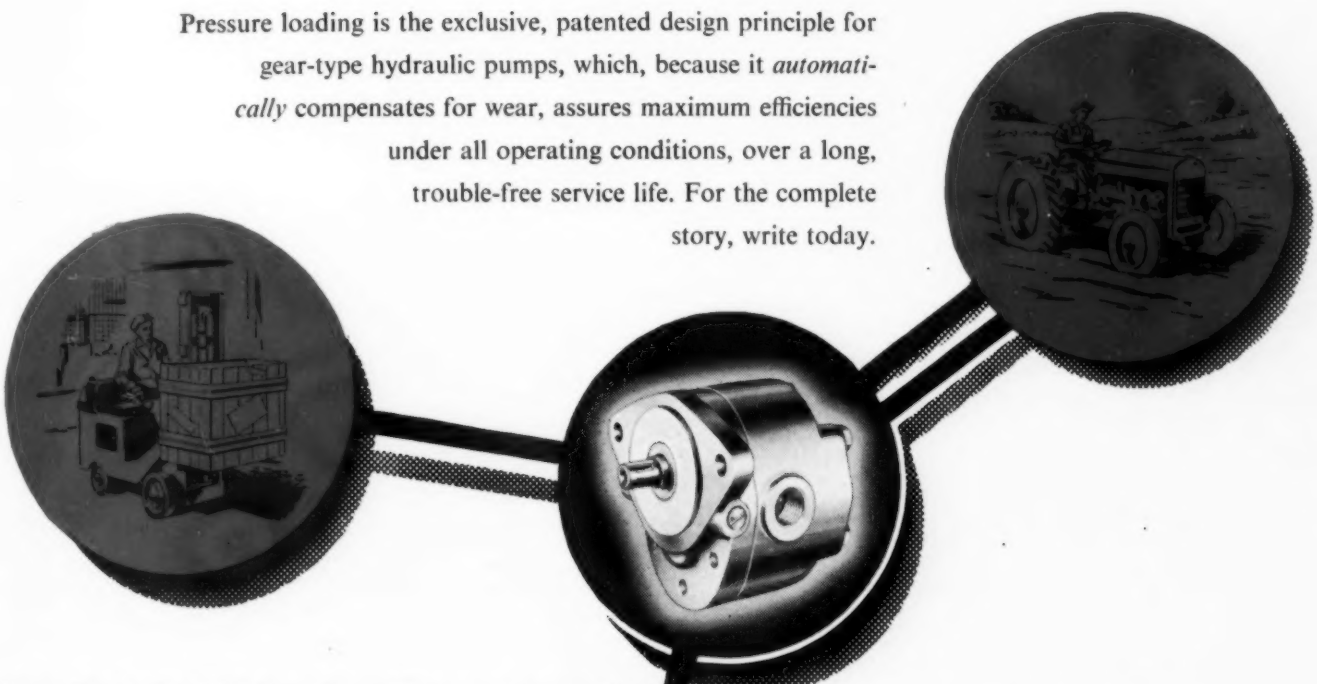
A major plus factor in the smooth coordination of the hydraulic maintenance program at Bendix is the habit, developed by the crew men themselves, of freely interchanging information on each service job. When a difficulty is encountered or an emergency stoppage occurs, routine duties are dropped and the maximum manpower, including apprentices, is concentrated on the problem. Notes on the trouble, its source and the corrective action taken, prepared for the individual machine record, are discussed and the procedure given to each member of the crew. In this way, all members of the maintenance crew keep familiar with each difficulty or machine stoppage and the action taken to get the machine back into production.

The hydraulic maintenance program at Bendix has been cumulative. Planning to insure adequate care of equipment was initiated at the very beginning. The fact that the same general foreman and the hydraulic maintenance foreman have both been on the job for 15 years or since the first hydraulic equipment came into the plant and that training, both on the job and in various schools, has been consistent and thorough, have been important factors in the success of this program.

Like good craftsmen everywhere, the foreman and members of the maintenance crew believe that improvements can be made in the job they do each day. They are a little surprised that their oil supplier, their packing source, service men of manufacturers of hydraulic equipment as well as their own management consider that they have, together, done an outstanding job.

Only Pesco hydraulic pumps offer "pressure loading"

Pressure loading is the exclusive, patented design principle for gear-type hydraulic pumps, which, because it *automatically* compensates for wear, assures maximum efficiencies under all operating conditions, over a long, trouble-free service life. For the complete story, write today.



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Circle 63 on Reader Service Card

M/Sgt. Hubert L. Lee, USA Medal of Honor

FOUR TIMES Sergeant Lee's platoon had taken, then lost, the hill near Ip-o-ri. On the fifth try, the sergeant, though hurt, was leading. A Red grenade hit him, seriously wounding both legs. Refusing assistance, he advanced by crawling, rising to his knees to fire. He caught a rifle bullet in the back. Still he wouldn't be stopped. Finally, with 12 survivors of his platoon, he took the hill, then let the stretcher-bearers carry him away. Today Sergeant Hubert Lee says:

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